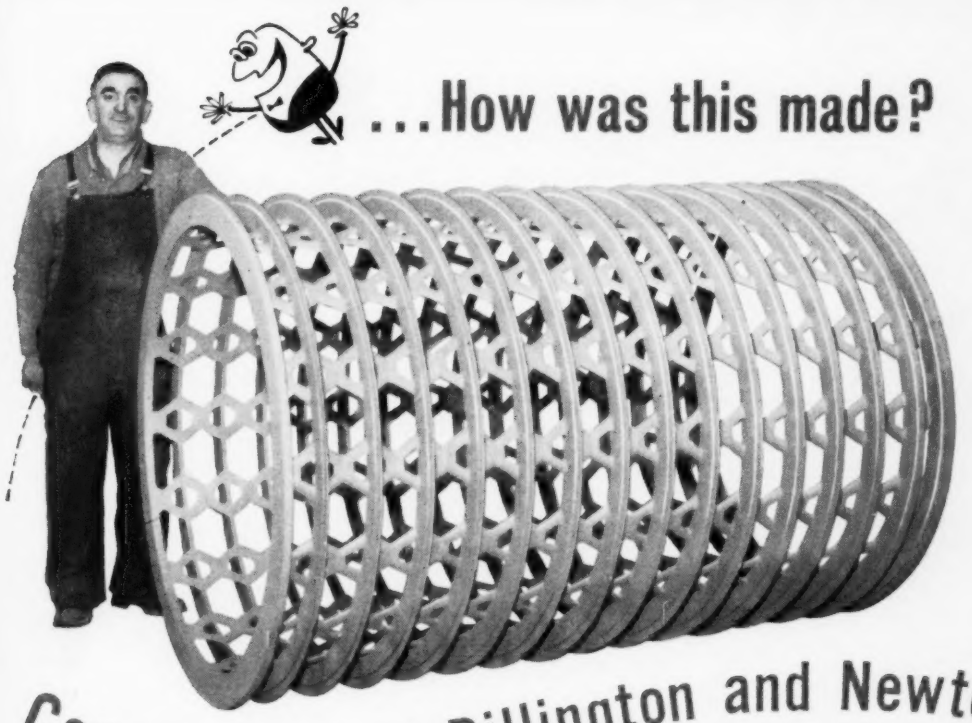
30 JUNE 1961

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS



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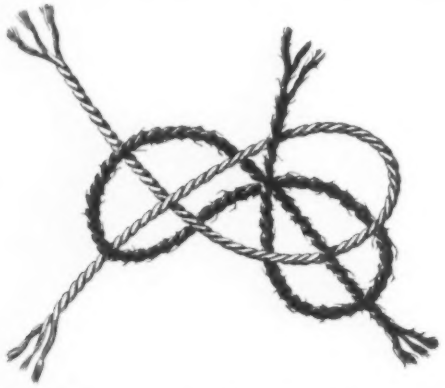

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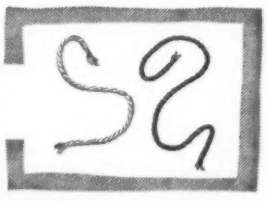

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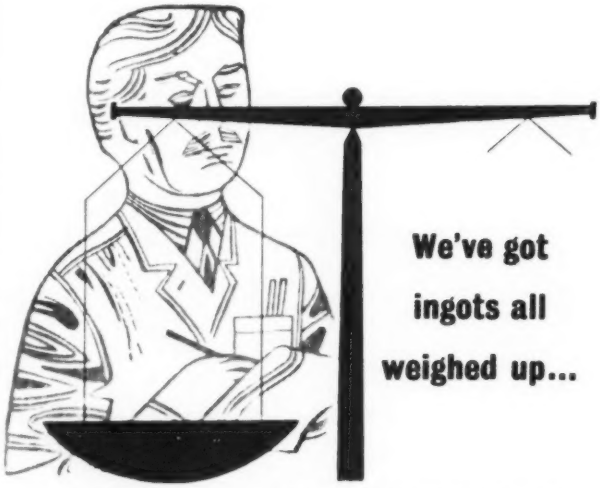

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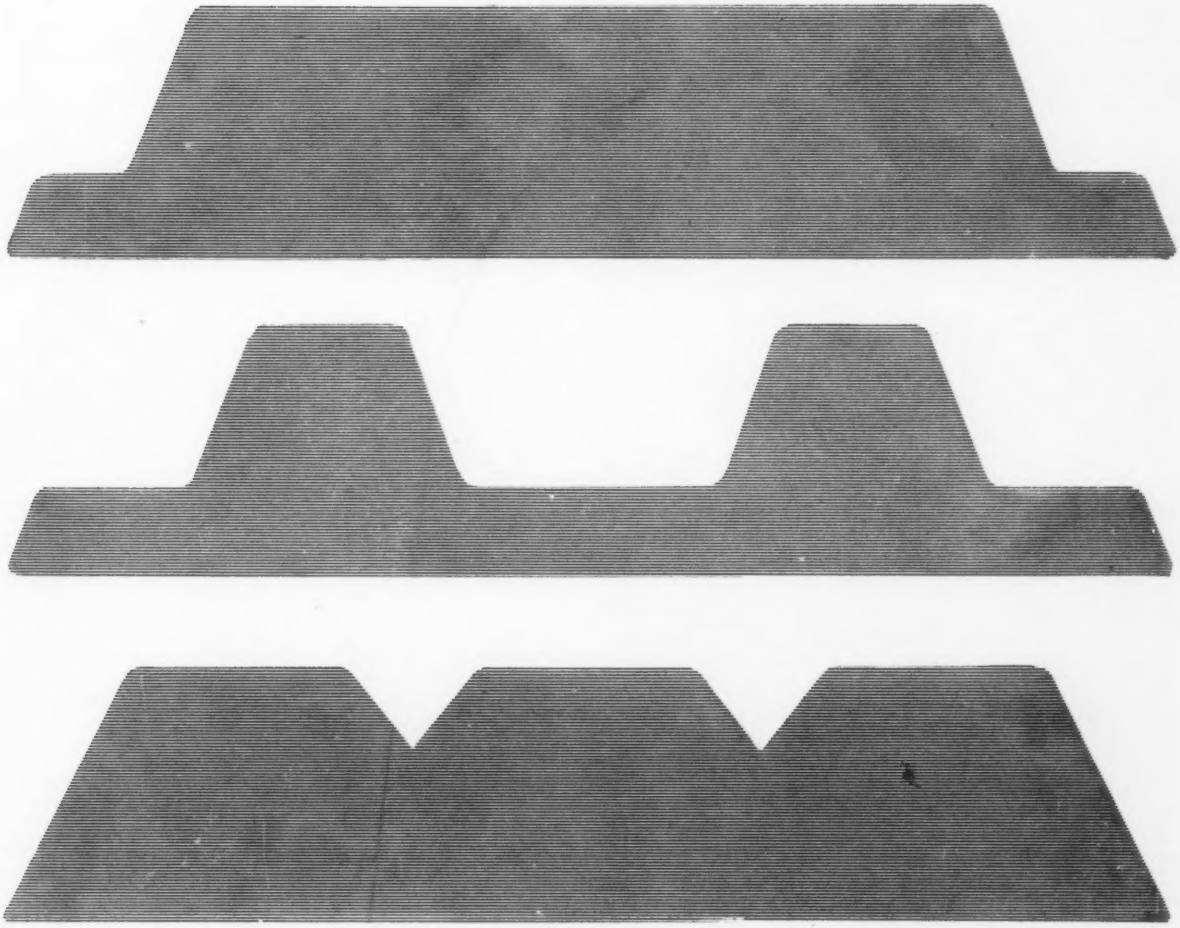

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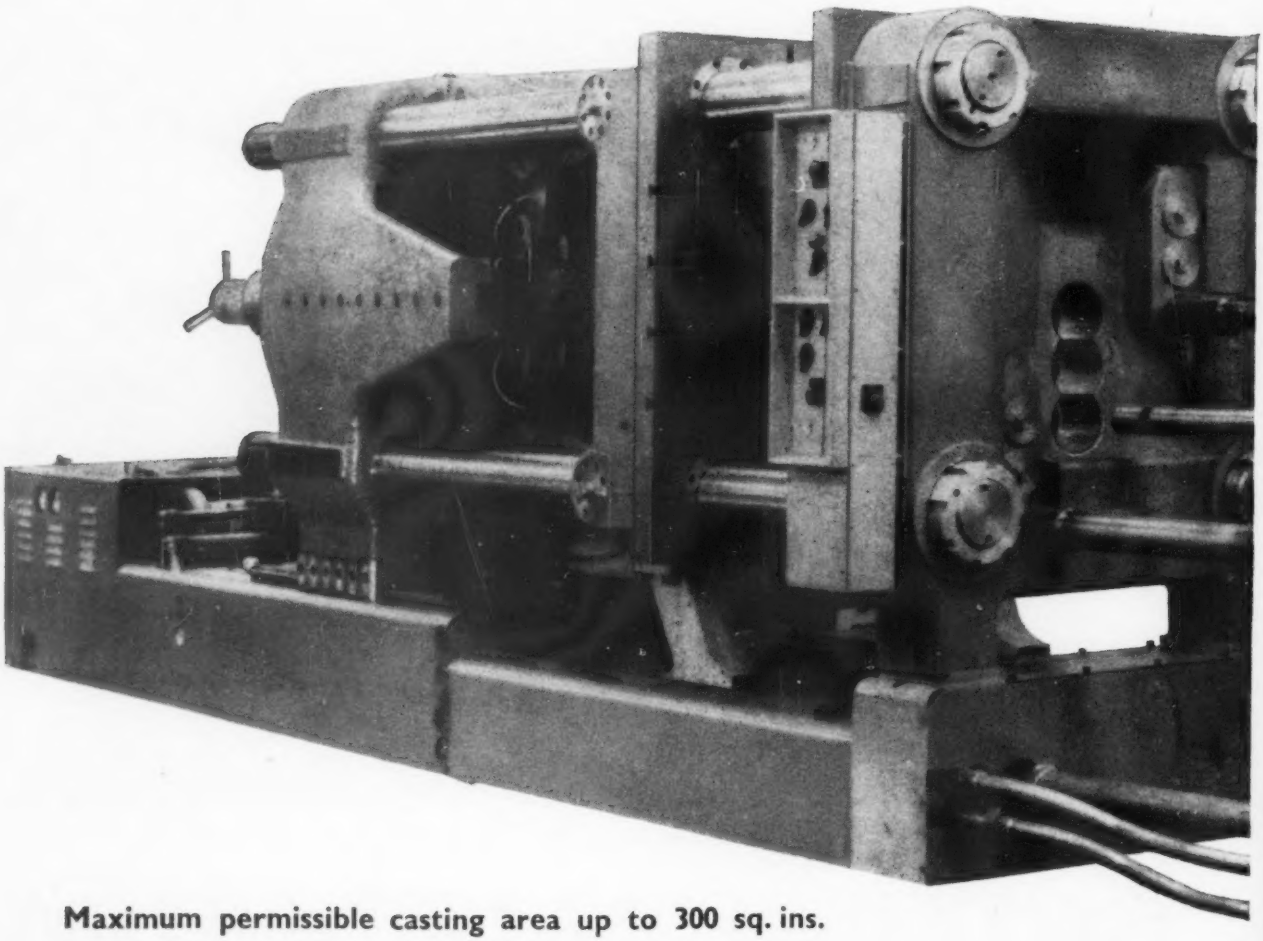

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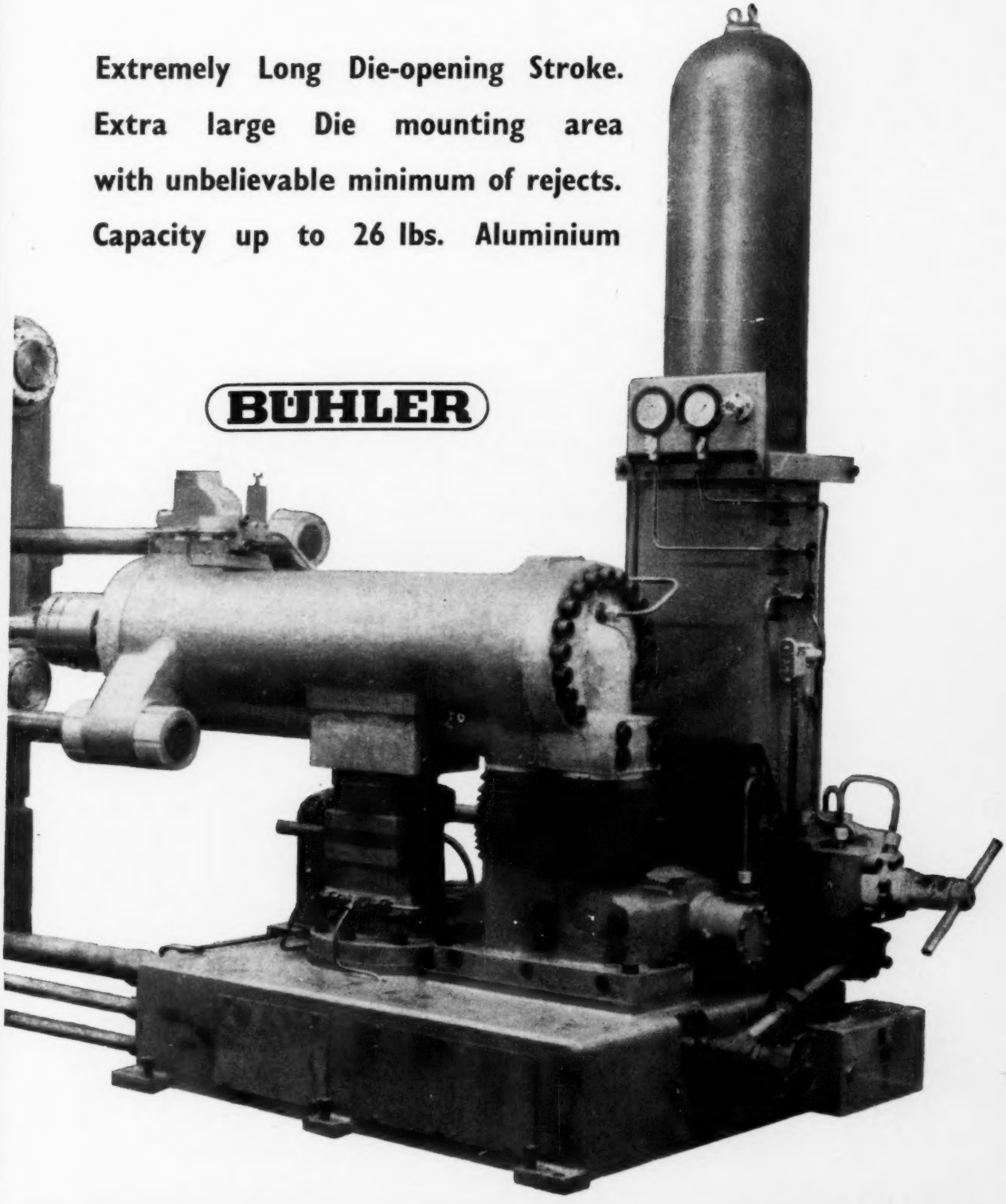

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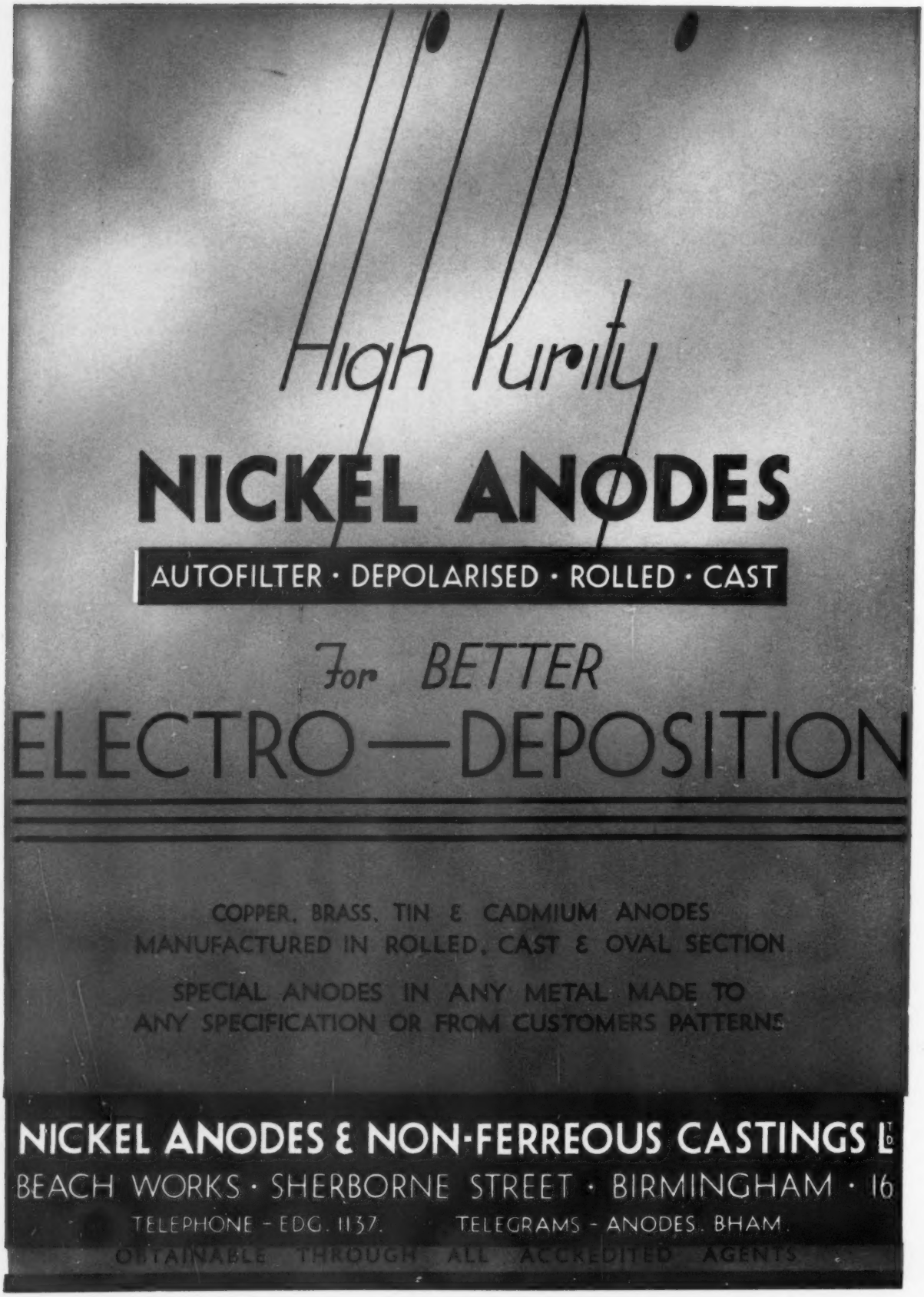
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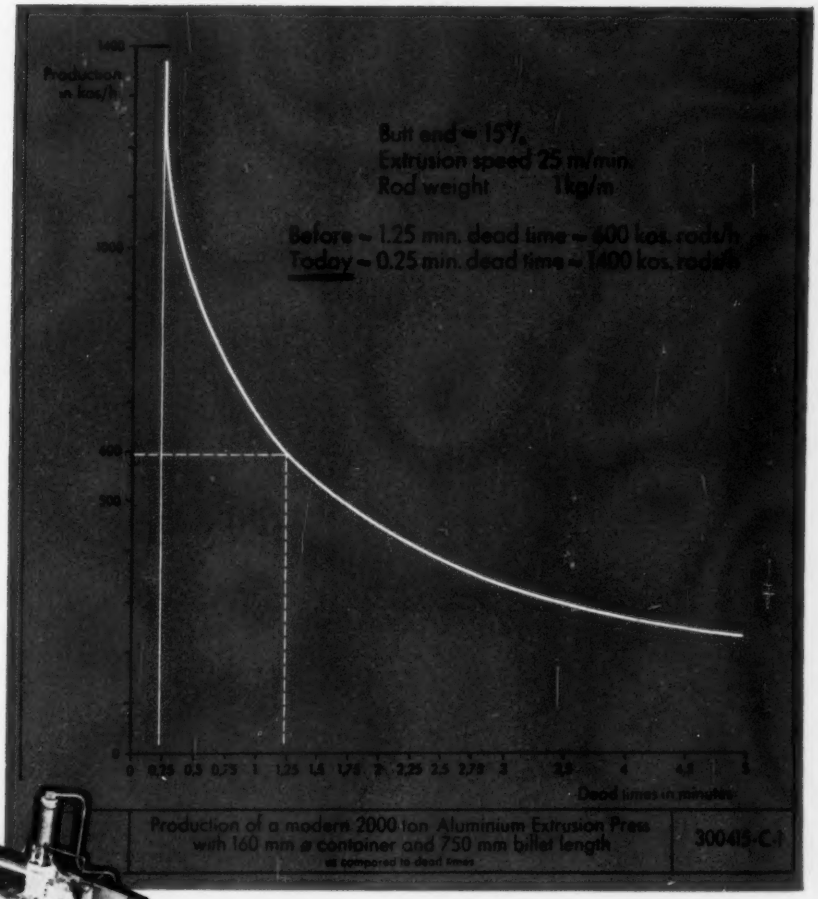
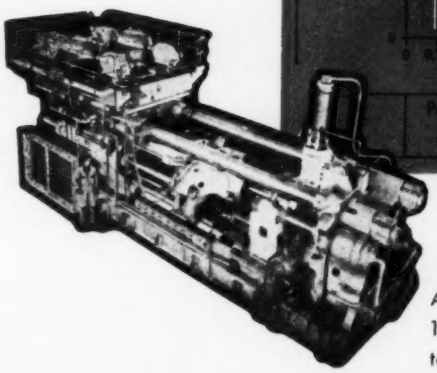

Production in kos/h
Butt end ~ 15%
Extrusion speed 25 m/min.
Rod weight 1 kg/m
Before ~ 1.25 min. dead time ~ 600 kos. rods/h
Today ~ 0.25 min. dead time ~ 1400 kos. rods/h
Dead times in minutes
Production of a modern 2000 ton Aluminium Extrusion Press with 160 mm ø container and 750 mm billet length as compared to dead times
30045-C-1



As a result, the output has increased from 600 kilos of rods per hour to 1400 kilos. This is over 130%. This example proves that it is worth while to seriously consider the LINDEMANN/LAKE ERIE Extrusion Presses. These up-to-date presses will help to modernise existing installations. LINDEMANN are always ready to help you in solving your extrusion problems. Experienced engineers are at your disposal. Please write to

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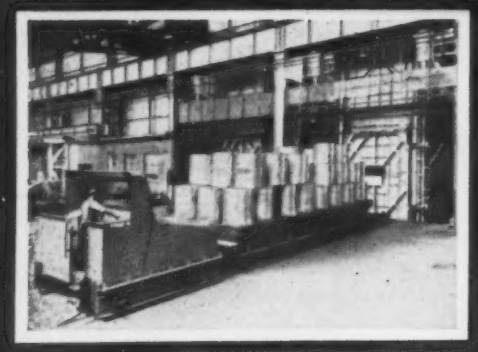

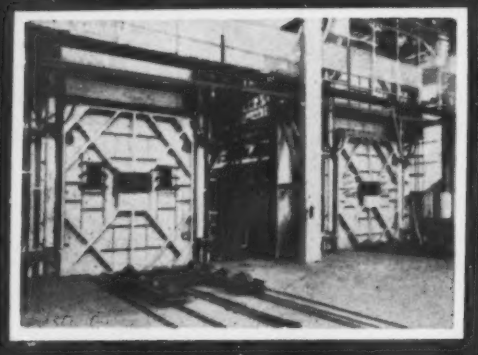

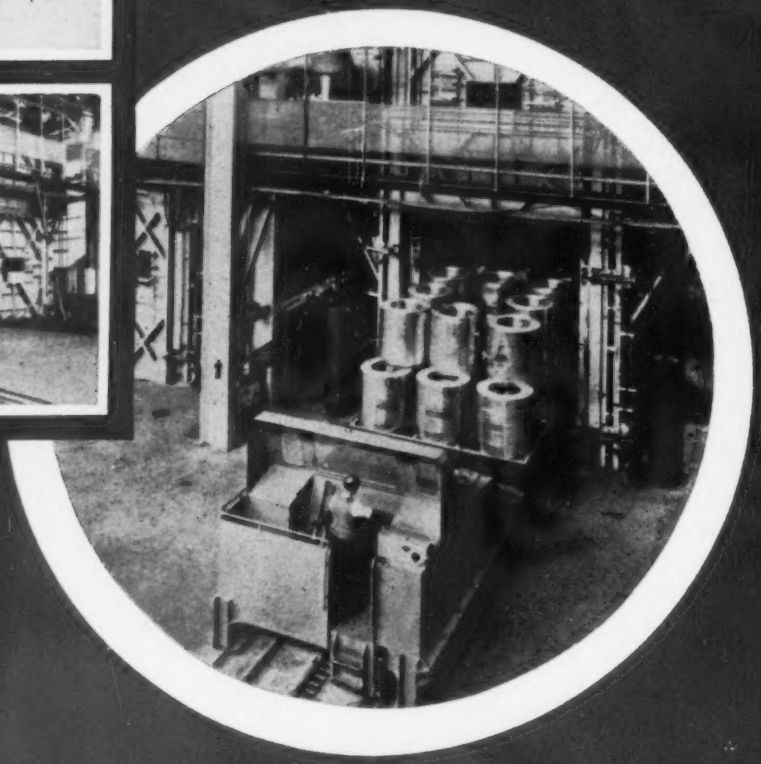

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30 JUNE 1961 VOLUME 98 NUMBER 26

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In some cases the existing procedure of a producer is accepted as the best practice of the art and is taken as a basis for the standard in question. Thus British Standard 1004 (Zinc Alloy for Die Casting) was based on the established practice of the Imperial Smelting Corporation in the production of Mazak.

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METAL INDUSTRY

VOLUME 98 NUMBER 26 30 JUNE 1961

Trading With West Germany

WITH her economy at full stretch and an unemployment figure of only 0·8 per cent, Western Germany's production is beginning to show gaps. Delivery times are lengthening and there are shortages. This fact is emphasized in the second report recently issued by the Export Council for Europe, which was formed in November last year at the instigation of the President of the Board of Trade for the purpose of expanding the exports of British goods and services to the other 19 countries which are members of the O.E.E.C. West Germany's vital statistics closely resemble those of the United Kingdom. There are striking parallels in size, population and industrial development. In both countries there is very full employment and the lurking bogey of inflation. In both, the only abundant raw material is coal. With German industry so fully employed, mechanization, automation, and all forms of labour-saving equipment are increasingly wanted. Modern specialization is so great that no one country can supply every need. If British products and techniques can measure up to the challenge of this rich, competitive market, says the report, there are great prizes to be won.

Firms which have gained a foothold in Germany should be prepared to maintain their effort. Technical and after-sales service is a prerequisite to sales of all plant and equipment. The German buyer, who is discriminating and can select from all the markets of the world, is impressed by British quality, but insistent that parts should be available immediately. Sales, promising at the outset, have been lost through lack of attention to this point. It is said that opportunities for an expansion of British exports are to be found within every sector of the German economy and in every part of the country. Among capital goods and machinery for which there are additional opportunities at present are such products as electronic equipment and components; machine tools for metal and woodworking; specialized tools for aircraft and shipbuilding industries; and scientific and measuring instruments.

Under the heading of base metal products, some interesting figures are quoted in the report. In 1959, the percentage share of total imports of copper bars, rods and sections into Western Germany from the U.K. was 34·3, but in 1960 this figure had fallen to 4·3. We were supplanted by Belgium in this market, who increased her percentage figure for the two years from 17·3 in 1959 to 57·6 in 1960, and by France, who tripled her figures. For copper plates, sheets, strip and foil the figures for U.K. were 9·6 per cent in 1959, dropping to 3·7 per cent in 1960. The variation was not so great for copper tubes and hollow bars, the figures being 67·9 per cent in 1959 and 63·9 per cent in 1960. In so far as nickel bars, rods, sections and wire, the percentage remained stationary at 30, and in nickel plates, sheets, strip and foil we did at least show an increase from 10·8 per cent in 1959 to 37·4 per cent in 1960.

These are only a few of the examples taken from the report, which goes on to say that top priority should be given to the encouragement of visits to Germany by managing, sales or export directors. No amount of statistics, market reports or other written material, however admirably done, can compare in value with personal contacts at board level, which can achieve great successes.

Out of the MELTING POT

Pure Approach

ADVOCATES of pure fundamental research should be delighted by the preliminary brief report of the first few results obtained from fatigue experiments on single crystals of indium antimonide. Delight may, of course, be tempered by the consideration that indium antimonide is an important semi-conducting material and that, therefore, even such an unlikely property—from the electronic point of view—as its fatigue strength might conceivably prove useful; but, perish the thought. In actual fact, the compound was chosen because certain of its electrical properties are very sensitive to plastic deformation, because it has some ductility at relatively low temperatures (the fatigue tests were run at 400°C.), and because dislocations are readily observed by standard etch pitting techniques. Studies of electrical properties and etch pit configurations in fatigued indium antimonide are in progress. The test results reported so far are presented in the form of a graph, in which the maximum plastic surface strain, in per cent, is plotted against the number of cycles to failure, both on a logarithmic scale. The slope of the straight line obtained (−0·5) agrees quite well with the slopes observed for a number of more common "engineering" metals. Striations arising from slip, and two types of cracks, both of which tend to occur at the boundary between two sets of intersecting slip bands, were observed in some of the indium antimonide specimens, particularly those which had been subjected to a relatively large number of cycles. Both types of cracks can be rationalized in terms of dislocation pile-ups. In an earlier general discussion of the straight-line relation between the logarithm of maximum strain and cycles to failure it had been suggested that this, too, could be rationalized in terms of dislocation intersections. From this basis it can be predicted that the number of intersections should be proportional to the square of the strain, thus accounting for the slope of −0·5. This implies that there is a critical number of dislocation intersections, and that when this number is exceeded, fracture results. The data obtained so far at least suggest that the fatigue process in indium antimonide is substantially the same as that in engineering metals. It is hoped that the studies of electrical properties and etch pit configurations will help to clarify further the nature and role of defects in fatigue phenomena.

Patchwork

WHEN we look back at the concept of continuous universal progress, held so dear by the Victorians, simple is the adjective that seems best fitted to describe that concept as it appears to us today. Although now abandoned, some of its constituents remain alive. One of them—the concept of continuous scientific and technological progress—has now widely supplanted the earlier universal concept. In this it has been, of course, greatly helped by the phenomenal growth in this field. So much so that the part that it is, is now frequently substituted for the now non-existent whole. Any gaps or shortcomings that become apparent are regarded as something that in due course will come within the scope of scientific and technical progress, but which, for the time being (until the particular bit of science has been developed and the scientists are allowed to take a hand) can be dealt with and advanced by other methods. Little wonder that the resulting patchwork keeps on tearing at the seams, if only because the numerous advances that are undoubtedly being made are just as likely as not to be made in different directions. If we are not forever to remain preoccupied with providing a stitch in time, or a lot more later, an attempt to eliminate the seams should be made; after which we could start and carry on with a form of progress just as good as the old one might by now have proved to be, had it not been analysed out of existence. Progress, like all other similar concepts, is indivisible.

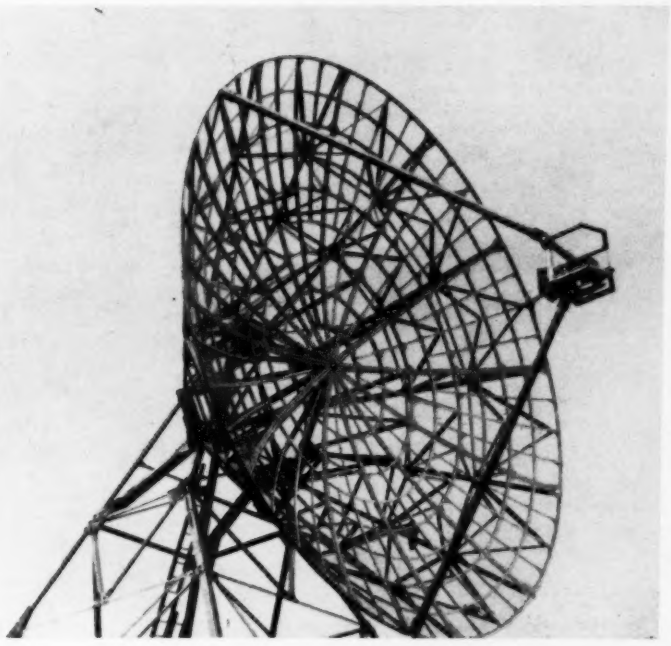
All Useful

THERE is, in all probability, no such thing as useless information. Any apparent lack of utility arises solely because of the ignorance of those who receive it and do not know what to do with it. That is one of the reasons for the question mark after the word "useless" provided as a title for a paragraph (this page, METAL INDUSTRY, 2 December 1960, p. 454) in which I lamented the lack of a great deal of such useless information. Fortunately, many research workers escape being influenced by the consideration that some information that they decide to seek out might appear useless. Thus, even as I was writing: "Or try to find some of the simple physical and mechanical properties . . . of such common intermetallic phases as $CuAl_2$ or $FeAl_3$ . . . nobody seems to have been sufficiently research-minded to have determined these useless properties"—a Paper on "Hot hardness and other properties of some binary intermetallic compounds of aluminium" had just been submitted to the Institute of Metals by Dr. E. R. Petty, of the Aluminium Research Laboratories Ltd., Banbury. And now a preprint of the Paper (No. 2070) has very kindly been sent to me, without comment save for a photostat copy of the page with the paragraph referred to above. Dr. Petty prepared specimens of the intermetallic compounds by casting, where possible, by sintering stoichiometric mixtures of the powdered constituents, or by recovering crystals of the compounds from aluminium alloys and hot pressing them. The Vickers hardness of the specimens obtained in these ways was measured at temperatures up to 600°C. under loads of 500 gm and 5 kgm. The important feature of the hardness/temperature curves of the intermetallic compounds is the inversion temperature. Some compounds begin to soften below the temperatures at which aluminium alloys containing them might be used or be hot worked, while other compounds remain hard and brittle beyond these temperatures. These two groups of compounds can, therefore, be expected to have different effects on the high-temperature behaviour of aluminium alloys or dispersion-hardened aluminium powder compositions containing them. In his Paper, Dr. Petty presents a literature survey covering various properties of the compounds with some of which properties (such as, for example, melting temperature and heat of formation) the measured hardness values have been found to correlate. He also mentions that a programme of work covering further aspects of the properties of intermetallic compounds and their influence on the behaviour of aluminium alloys is in hand.

Skimmer

Sixth International Galvanizing Conference

(*Continued from* METAL INDUSTRY, 23 *June*, 1961



With a total weight of about 8 tons of galvanized steel, this tropospheric scatter aerial is one of four erected to provide a telephone link between Barbados and Trinidad [Courtesy Marconi's Wireless and Telegraphic Co. Ltd.

IN the second part of the second technical session at the Sixth International Galvanizing Conference at Interlaken, two Papers were presented and discussed. They were "The Effect of Hot Galvanizing on the Mechanical Properties of Steel Sections", by H. Wiegand, and "The Adhesion of Galvanized Coatings", by H. Bablik, J. Krystof, F. Götzl and E. Nell.

Abstracts of the two Papers presented are given on this and the following page. The chairman at this session was **Mr. O. Graverson** (Denmark).

Supporting evidence for the statement in Wiegand's Paper that it is bad to quench in water because cracks in the coating impair fatigue resistance was sought by **Mr. W. L. Hall.** In his experience small fittings subjected to fluctuating stresses were regularly quenched and the treatment was not dangerous.

Referring to the Paper by Bablik and his co-workers, **Mr. R. C. Bell** queried the statements that pure zinc is preferable and remelted zinc is unsuitable if good adhesion is to be obtained. He pointed out that no analyses of the electrolytic zinc used were given. The effect of lead, for instance, is influenced by the type of zinc. The results of Bablik with regard to lead were not in agreement with his own work or that of other investigators using a different adhesion test. In practice it was found that zinc baths could tolerate a reasonably wide range of impurities.

Bablik's results with respect to lead were at variance with those of the British Non-Ferrous Metals Research Association, said **Mr. E. C. Mantle.** Judged by the adhesion bend test, lead had no deleterious effect with short immersion times. The surface roughness of the steel, however, did have a noticeable effect and he was rather suspicious of the test used in the Paper.

Confirmation of this view came from **Mr. D. I. Cameron** who pointed out that the adhesion measured by Bablik's test, was different from that normally dealt with in the bend test, remarking that the authors have measured the resistance of the coatings to being pulled off the sheet without bending.

This is of fundamental interest although it does not appear to link with the adhesion problems concerned with the bending of a brittle alloy layer.

It will be most interesting to see if these test results can be related also to failure in bending.

In investigating adhesion we have tested under production conditions over a hundred loads each of several tons of steel sheets in a bath with lead and a little tin, but no aluminium.

Tests were by a folding test (four thicknesses), a seaming test or the Youngstown test. From a statistical analysis the folding test responds a little differently to the seaming test or the Youngstown test, for both of which the surface of the steel base is probably taken nearer to failure.

The beneficial effects of the silicon which the authors mention showed up on the seaming and Youngstown, but not on the folding test.

A beneficial effect of high temperatures for the acid bath ahead of the pot showed up for all tests.

It was also established that adhesion was affected by one of the rolling variables, and also by one of the annealing variables, but we are not sure which of several factors are

The Effect of Hot Galvanizing on the Mechanical Properties of Steel Sections

By H. WIEGAND

IT is well known that the reactivity between steel and molten zinc increases with increasing carbon and silicon in the steel. The consequential growth of the brittle and harder iron-zinc alloys affects the properties of the steel and so high-carbon or silicon steels, especially silicon-killed steels, are generally avoided. However, it is unwise to reject silicon-killed steels altogether, although aluminium should be used for deoxidation to avoid undesirable ageing effects. Other alloy additions to steel, e.g. copper, molybdenum and titanium, also increase zinc pick-up but to a lesser extent than carbon or silicon.

The metallurgical aspects of hot galvanizing have been considered with special reference to the influence of galvanizing on stressed test bars and structural sections. Alloy brittleness, similar to that found in hard-soldering, may occur in hot galvanizing. The major factor is the "critical" tensile stress present in the section to be galvanized, whose magnitude will depend on the steel composition and the design and method of assembly of the structure. The immersion (or wetting) time in the molten zinc is also important, but the individual significance of each of the various factors has not yet been established.

Current investigations have shown that, provided certain precautions are observed with regard to choice of plate material, and also construction and processing technique, the operational behaviour of structures subjected to impact or fatigue stress will be little impaired by galvanizing.

The Adhesion of Galvanized Coatings

By H. BABLIK, J. KRYSTOF, F. GÖTZL and E. NELL

MARKEDLY improved adhesion was observed in the case of steels which gave "beard" type coatings. The improvement only occurred if the immersion time exceeded 4 min. It appears that strong pickling has a beneficial effect on adhesion.

From the tests so far carried out it is possible to state tentatively that mechanical roughening or filing does not affect coating adhesion.

Immersion time affects the coating thickness, but, with the exception of the "beard-forming" steels, it was found that there was no marked effect on adhesion after immersion times of 1, 2, 4 and 8 min. After 15 min., however, the adhesion fell drastically.

The chemical and physical properties of the reactants have an influence on coating adhesion. The good adhesion of coatings produced in baths of pure electrolytic zinc is decreased by the various alloy additions. The addition of 0·4 per cent lead causes a marked drop in adhesion and it is still further decreased by the addition of antimony, antimony and copper, or antimony, copper and magnesium. Pure zinc is always preferable if good adhesion and flexibility are required. The results clearly indicate that re-melted zinc with its additional impurities is really unsuitable for galvanizing.

The adhesion of a coating produced in baths of pure electrolytic zinc is reduced by about 50 per cent on the addition of 0·02 per cent Pb alone and by about 66 per cent on the addition of 0·02 per cent Pb + 0·05 per cent Al.

responsible. It has long been known that the free zinc will separate from the alloy layer if a sheet is stopped over the flue of a galvanizing pot.

There is a similar failure possible with some loads of cold reduced and annealed steel sheets.

A thin surface layer of the steel is affected, so that if the cooling is at all retarded, the free zinc will spontaneously separate from the alloy layer, though the coating still looks perfect.

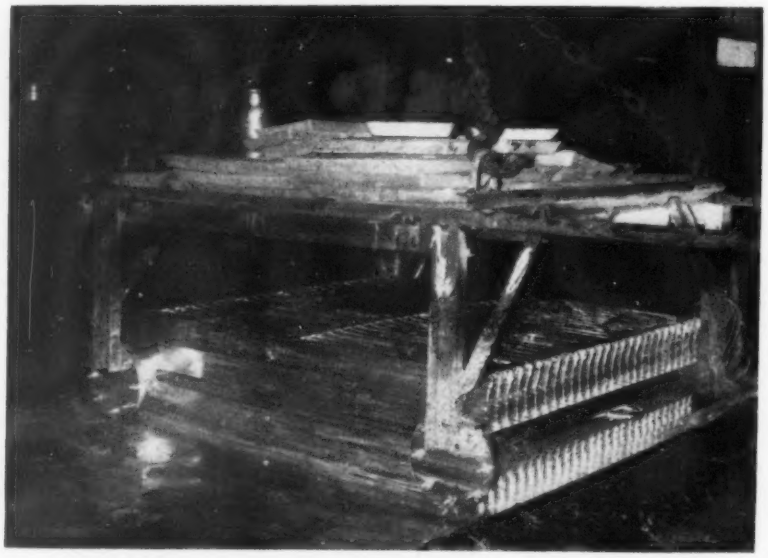
If the surface layer is removed by any means, or if cooling is accelerated through a critical range about 390° C., the trouble is avoided.

These are factors affecting adhesion different from those described in the Paper which can be mentioned.

A.S.T.M. tests, said **Mr. J. F. H. van Eijnsbergen** do not indicate adhesion alone. Adhesion proper can only be measured at the interface and has nothing to do with surface roughness.

An impact test devised by himself and his colleagues and used for quality control in his works was described by **Mr. H. Edwards.** It consists of producing a $\frac{5}{16}$ in. deep cup by means of an 0·84 in. dia. punch with an hemispherical end attached to a falling weight. This test has been found to be severe and discriminating. If flaking occurs, the extent is classified by the use of standards and the product is allocated accordingly.

The use of a silicon treated steel for galvanizing, he said, should be approached with caution because of the sometimes detrimental effect of silicate inclusions on ductility.



Radiator being withdrawn from a galvanizing bath

Welding of Galvanized Steel

Welding of galvanized steel formed the subject of the third session under the chairmanship of **Dr. R. Haarmann** (Germany). The three Papers presented were: "The Weldability of Hot Galvanized Steels" by R. Boekholt, "The Assembly of Galvanized Steel by Welding" by M. Puech and "The Reconditioning of Damaged Galvanized Surfaces" by J. F. H. van Eijnsbergen, R. Gloor and J. R. Rouff. They are abstracted on this and the following page.

Results of 5 year outdoor exposure tests in marine and industrial environments of reconditioned galvanized parts were reported by **Mr. E. C. Mantle.** All the treatments, he said, were effective. Zinc-sprayed parts showed no corrosion at all after 4 years exposure; those treated with a zinc-rich primer and aluminium paint showed slight rusting. Complete protection in the marine atmosphere was obtained with

Weldability of Hot Galvanized Steel

By R. BOEKHOLT

THE rate of travel has a predominant effect on the welding properties. The very high rates of travel in automatic welding produced gas inclusions in the weld and an irregular welding process, with the result that the appearance of the weld became very rough. Weldability was poor and not acceptable.

When downhand welding standing fillet joints, the rates of travel with various types of electrode are higher than for other joint shapes. The best results were obtained with an electrode of the rutile organic coated type with a thin-flowing slag.

The choice of electrode was found to affect the welding properties, particularly the fluidity of the slag. The electrodes with a thin-flowing slag often retained their welding properties, whereas the very rapidly solidifying types caused excessive spatter and a rough appearance of the weld.

The weldability of galvanized steel structures is good, provided that the correct electrode is chosen and the rates of travel are not too high.

The mechanical properties of welded joints on galvanized steel are practically the same as those on ungalvanized steel.

The crack sensitivity of welded joints on galvanized steel is greater if welding is done with a rutile electrode. Low-hydrogen electrodes are recommended for welds where there is a risk of crack-formation; or the zinc coating must be burnt away locally.

For welding in small and medium sized workshops an exhaust installation is necessary.

A group at the reception: Mr. C. R. Lyons, Mr. and Mrs. W. R. Thompson and Mr. Dickenson

zinc-rich paint, and only slight rusting at the industrial site. Calcium plumbate paint, on the other hand, resisted attack in the industrial atmosphere and showed slight rusting in the marine.

He was surprised at the suggestion in the Paper by Puech that bronze welding offered an alternative for the construction of hot water tanks etc. He would have thought that the copper-base alloy would cause accelerated attack on the steel.

Improved methods of joining galvanized steel were required by the automobile industry, said **Dr. S. Radtke.** Resistance welding was used in U.S.A. for such parts as silencers. The difficulty was that the copper-base alloy electrodes failed at high speed production because of the formation of dross at the interface. With slow runs the effect was not significant.

Different thicknesses could be satisfactorily welded, according to **Dr. R. Haarmann,** citing the joining of 0·030 in. to 0·080 in. gauge. The fatigue resistance of welded joints was outstanding provided a steel-to-steel joint was obtained. There was no problem with the welding on of such items as brackets and galvanized sheets were easier to deep draw without fracture.

Seam welding, said **Mr. J. R. Rouff,** can be done successfully with copper-zirconium or copper-chromium electrodes although 25 per cent more current was required. The electrodes should be cold worked to maximum physical properties and redressed more frequently. The shape of the electrode was critical; it should provide maximum support for the welding face.

Replying to Mr. Mantle, **Mr. M. Puech** said that accelerated corrosion tests up to 300 hours duration had shown that bronze and copper welding of galvanized parts was quite successful

To this **Mr. E. C. Mantle** replied that salt spray tests should be avoided, the results obtained not being comparable with those obtained in service.

Corrosion of Zinc

Papers, abstracted on page 514, on wet storage stain, and the corrosion of zinc formed the subject of discussion in the fourth session, with **Mr. A. P. Ollivet** (France) in the chair.

The practical implications of the Paper by Weast and his colleagues were referred to by **Mr. W. L. Hall** who said that

Delegates at the Conference Banquet: Mr. F. C. Braby, Mr. G. R. Faulks, Mr. and Mrs. W. A. Jenkins, Mr. E. C. Mantle, Mr. D. I. Cameron, Mr. W. L. Hall

Assembly of Galvanized Steel by Welding

By M. PUECH

BUTT, lap and fillet welds, produced with both rutile cellulose and basic-coated electrodes, were examined.

The tests were designed to study: 1. *The quality of the welds;* 2. *The mechanical properties of the welded joint; and* 3. *The corrosion resistance of reconditioned surfaces.*

The results indicate that the presence of a galvanized coating on the steel plate does not affect the quality of the weld.

The presence of zinc during welding does not affect the tensile properties of that weld, and galvanizing does not affect the strength of the plate itself.

With one exception, galvanizing did not affect the impact strength of the steel plate. The basic electrode welds had double the strength of black steel and the rutile electrode welds also showed improved impact values, although to a lesser extent in the galvanized specimens.

Reconditioning of Damaged Galvanized Surfaces

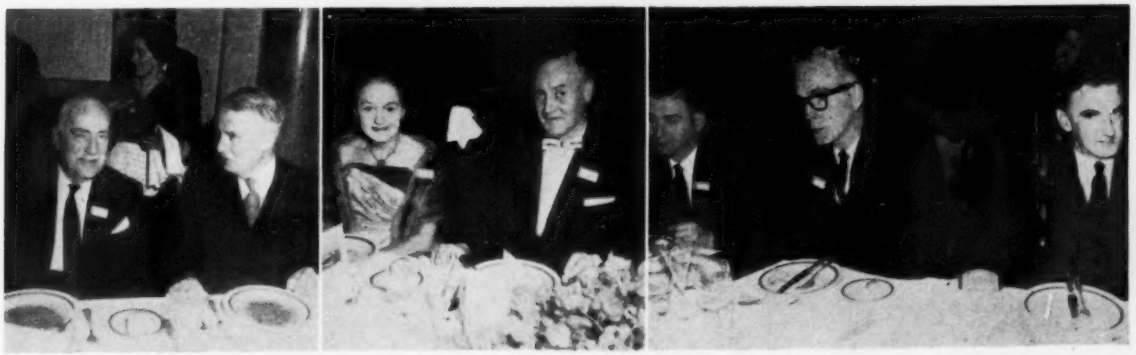
By J. F. H. VAN EIJNSBERGEN, R. GLOOR and J. R. ROUFF

DAMAGED spots on freshly galvanized items can be repaired by means of zinc-rich paints, zinc spraying or repair sticks consisting of zinc or zinc alloys. In isolated cases zinc alloy powders, tin solder and anti-corrosive paints are also used.

Provided the spots are adequately cleaned and pretreated, sufficiently thick and non-porous coats of these products will give a corrosion resistance equal to that of the adjoining areas of the hot galvanized structure.

In very moist atmospheres a zinc-rich paint or a repair stick give better results than zinc chromate or calcium plumbate.

A coat of aluminium paint applied over a zinc-rich paint or sprayed zinc coating increases corrosion resistance and mitigates differences in appearance.



Tests on Wet Storage Stain

By W. S. WILCOX and E. B. DISMUKES

A SURVEY has been made of various methods of protecting galvanized sheet against white rusting, but no method that has been investigated can be endorsed unequivocally as an alternative to chromate treatment. One feature of chromate inhibition that has proved difficult to approach with other agents is inhibition at concentrations as low as 10^{-4} molar.

Comparisons of aluminium-containing and aluminium-free sheet give some quantitative support for the often expressed view that wet storage stain is more severe on continuously galvanized strip which usually contains aluminium in the coating.

Methods for evaluating the white rusting of galvanized sheet have been investigated. From the standpoint of convenience and reproducibility, the methods involving immersion in distilled water—either leading to a weight-loss determination or to an instrumental detection of the rate of white rust formation—may be found useful for quality control in galvanized sheet production.

The Corrosion of Zinc in Dilute Aqueous Solutions

By R. C. WEAST, L. J. KOTNIK and D. M. GEEHAN

WHEN zinc corrodes in aqueous systems pressurized with air or oxygen there is no maximum in the corrosion rate at 60°C. contrary to previous results. For a given solution and a given oxygen concentration the corrosion rate of zinc is only a function of the solution temperature. Zinc potentials become enobled in chloride solutions even in the absence of carbonates, bicarbonates or nitrates if the zinc corrodes in systems pressurized with air or oxygen. Oxidizing agents that do not produce molecular oxygen and which do not form insoluble zinc compounds do not cause enoblement of the zinc potential. The quantity of zinc corrosion which occurs during the first 24 hours in hot potassium chloride solutions under pressure is the same if the temperature is between 50°C. and 80°C. The ratio of amounts of ZnO and $Zn(OH)_2$ occurring in the corrosion products is a function of the time the metal has corroded. The zinc corrosion products formed at 88°C. are about 1,000 times more electrically conductive than those produced at 25°C. The corrosion products of zinc in very dilute aqueous solutions are produced by a stepwise process which involves replacement of water molecules on the hydrated zinc ion.

The Painting of Hot Galvanized Steel

By J. F. H. VAN EIJNSBERGEN

NEW phosphate treatments and the extended use of several one-component stable wash-primers are discussed, together with the finishing coats to be used. The use of calcium orthoplumbate (COP) paints on galvanized steel has become increasingly important as new types of paints based on synthetic resins have been developed. The principles on which the lasting adhesion of COP paint films is based are discussed at length and details are given on the general composition of suitable COP paints (vehicle, pigments and solvents). A tentative specification is given for air-drying COP paints on hot galvanized steel, together with some recommendations as to their ingredients.

Chromating

By C. W. OSTRANDER

CHROMATE conversion coatings appear to give the best protection against white corrosion under humid storage conditions and in marine environments; in addition, they improve the bonding of paint to the zinc surface.

Water soluble chromium compounds of one type or another have been used in strip galvanizing to eliminate wet storage stain. In most cases the chromate solution does not react chemically with the metal surface to form what is known as a true "chromate conversion coating", i.e. no zinc metal is dissolved and the necessary chemical reaction with the zinc does not take place.

The simplest type of treatment used today closely follows the German development in which the galvanized strip is run through a hot solution of chromic acid, or sodium or potassium chromate, immediately after galvanizing. The solution is then lightly rinsed, or merely squeegeed off the surface, and the sheet dried.

The most effective treatment is a chromate conversion coating formed in an aqueous solution containing hexavalent chromium plus acid activators and film-forming agents. Coatings produced by this process not only supply soluble hexavalent chromium, but also include insoluble trivalent chromium, which acts as a binder and decreases the solubility rate of the protective film, thereby providing corrosion resistance over longer periods of time. The coating, which is chemically bonded to the surface, will not flake or chip off, nor does it react under corrosive conditions to form stains or other objectionable by-products. The amount of metal removed in the process is extremely small and of no consequence.

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it was the first time that the effect of pressure on the corrosion of zinc had been considered. This was most important in hot water systems working under the pressure of water mains. The effect of pressure was to cause corrosion at a greater rate. Did the overall rate remain the same?

He was amazed that Wilcox favoured a test which immersed the specimens in distilled water, a test which bore no resemblance to the conditions in practice.

Any accelerated test left much to be desired, said **Dr. S. Radtke** and every effort should be made to simulate practical conditions.

Replying, Prof. R. C. Weast, said that the rate of corrosion does decrease with pressure. With air at 3 atm pressure corrosion was less than with oxygen at 3 atm. Magnesium anodes were beneficial in retarding corrosion but offered no protection if the conductivity of the water was low.

Protection of Galvanized Coatings

Protection of galvanized coatings by chromating and by painting formed the subject of discussion at the fifth session when the two Papers abstracted on this page were presented. **Mr. A. P. Ollivet** (France) occupied the chair.

Both chromating and painting, said **Mr. O. Schulze,** prevented white rust and increased the durability of galvanized parts. A strict comparison of the various processes was not possible—each had its merits.

The incorporation of calcium plumbate invariably gives a considerable improvement in adhesion, said **Mr. A. G. Walker.** Comparing various treatments he quoted experiments where specimens were pretreated in three ways—white spirit wash—phosphoric acid—two-pack etch primer and then painted with three different paints—oil-base calcium plumbate—oil-base lead—phenolic primer.

After 4½ years exposure the specimens were tested by the scratch adhesion tests. When using the rating 1 as very good and 10 as very bad the following results were obtained.

	Untreated	White Spirit	Phosphoric Acid	Etch Primer
Calcium Plumbate	2	1	1	2
Oil-base Lead	6	6	6	3
Phenolic Primer	5	6	4	3

Mr. P. Lutz asked whether there was any reason why an aluminium-free zinc coating was less susceptible to white rust.

Replying to a question **Mr. C. W. Ostrander** said that both clear and coloured chromates could be applied as a quench immediately after galvanizing. At present there were no applications for coloured chromates but there were no practical difficulties in their use. Potassium dichromate was still used as a quench but in his experience chromates plus other ingredients provide greater corrosion protection.

(To be continued)

RECENT PLANT EXTENSIONS AT ENFIELD ROLLING MILLS

Continuous Cast Rod and Tube

FOR the continuous casting of Encon rods, tubes and shapes, major plant extensions have recently been completed at the Brimsdown, Enfield, Middlesex, factory of Enfield Rolling Mills Limited. The new installation has doubled production and permitted a wider range of sizes and materials to be held in stock, enabling delivery to be made at short notice from over 1,500 stock items.

New storage and despatch facilities have been erected for delivery direct to customers and depots at Newcastle, Paisley, Cardiff, Belfast, Leicester and Manchester.

The wide range of Encon materials and sizes enables appropriate size of rod and tube to be selected for bushes, bearings and other parts. By choosing the correct size, machining time, metal and tool wear are saved. Exact lengths up to 12 ft. can be supplied, thereby saving metal usually wasted by short end scrap. In contrast to metal cast by other methods, continuous cast rod and tube are completely free from blowholes and all other casting defects.

By comparison with sand and chill cast metals, the properties are striking. For B.S.1400-PB1 alloy the elongation is 10 per cent minimum (chill 3 per cent and sand 1·5 per cent) and the U.T.S. is 23 tons/in^2 minimum (chill 19 and sand 13 tons/in^2).

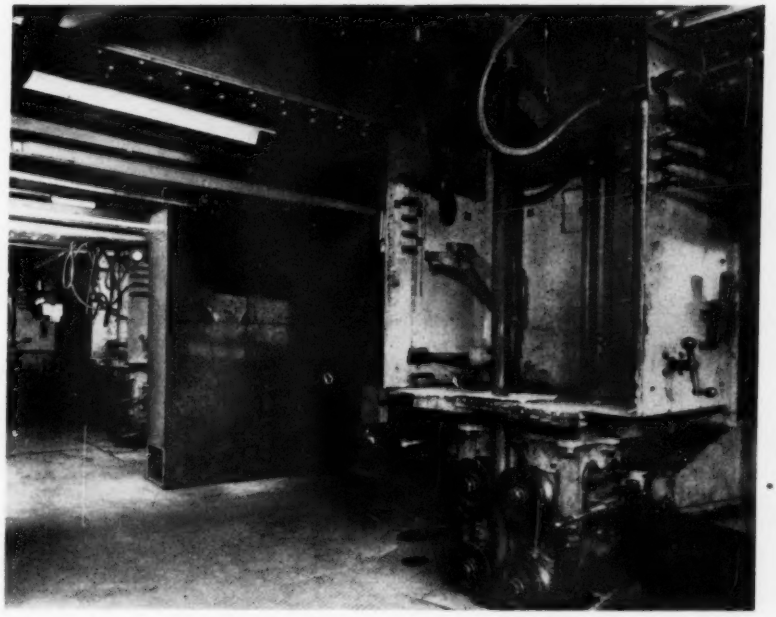


Fig. 1—General view of the casting floor, part of the recent major extensions at the Brimsdown plant of Enfield Rolling Mills Ltd.

Production Range

Continuous castings are made to any of the B.S.1400 Specifications for phosphor bronzes, leaded phosphor bronzes, gunmetals and leaded gunmetals. Castings are also made to other specifications as required. Stock sizes for rod are $\frac{7}{16}$ in. to $6\frac{1}{16}$ in. dia., and for tube $\frac{3}{8}$ in. to $6\frac{1}{16}$ in. o.d., with a minimum i.d. of $\frac{1}{32}$ in. Lengths greater than 12 ft. can be supplied if necessary, and all bars are mechanically straightened to give no more than $\frac{1}{4}$ in. arc depth in 5 ft. The dimensional tolerance on continuously cast rod and tube is o.d. +0·004 −0·006 in.; tubes are concentric to within $1\frac{1}{2}$ per cent of wall thickness.

Casting Method

The continuous casting plant is similar to that developed by the American Smelting and Refining Company, of New Jersey, and is operated under licence from that company. The method is, in principle, extremely simple: the virgin metals are melted, held in an atmosphere of nitrogen, and cast through graphite dies; the vertical cast bar passes through guide rollers on the floor below the die, and is cut off into lengths on a lower floor. Considerable care and laboratory control are exercised to achieve the casting perfection and dimensional tolerances required in Encon materials; particular ingenuity is needed for the design and construction of the dies necessary for the casting of complicated shapes.

In the process, the constituents of the alloy to be melted are weighed out into skips in wheeled bogies, and elevated to the top floor of the four-storey casting building. They are then tipped into a 500 lb. capacity Birlec-

Fig. 2—General view of the furnace floor

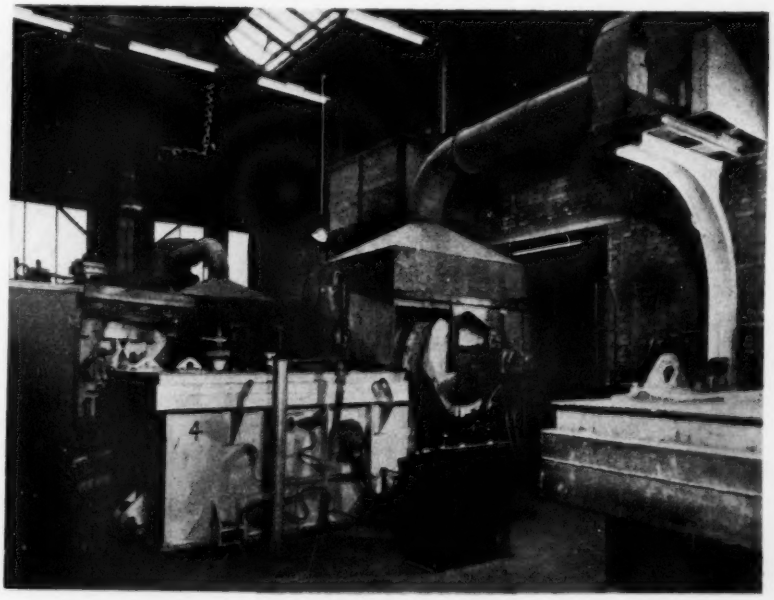


Fig. 3—Two flying cut-off machines

Detroit rocking arc furnace. When the melt is ready, the arc furnace is tipped hydraulically and the molten alloy transferred to the charging box of the continuous casting furnace, which is heated by carbon resistors. An inert atmosphere of nitrogen is maintained in the furnace to prevent oxidation of the melt. The graphite die is located in a water-cooling jacket at the base of a graphite crucible; a shut-off plug is provided to close the channel through which the molten metal flows to the die, the handle controlling this plug being on the casting floor below the furnace.

To start the casting operation, a starter bar is inserted into the underside of the die and, with the furnace shut-off plug in the open position, the starter bar is drawn steadily down by the roll mechanism on the casting floor. The speed of withdrawal is adjusted so that the metal freezes as it passes through the cooled die. By the time the metal reaches the outlet of the die, it is sufficiently solid to support the mass of liquid metal above, and casting continues as long as the cooled metal is withdrawn at constant speed from the die. The starter bar is removed when the cast bar or tube emerges from the roll mechanism.

Cutting-off Equipment

The newly-cast bar or tube is cut into lengths by a horizontal resin-bonded abrasive wheel. The cutting-off unit is clamped on to the downward-moving stock and is counterpoised by a heavy weight or by hydraulic means; it is aligned by rollers running on the faces of a vertical steel column of hexagonal cross-section. The cut section is received in a vertical tube which is pivoted so that the cut sections may be drawn out on to a horizontal roller-type run-out table. The tube or rod is inspected and dimensionally checked on this table and, after being straightened on a Farmer Norton machine, is passed to stock or for despatch, as may be required.

Die Life

The life of a die in continuous duty can exceed 100 hr., but as a new die is used each time a particular size is cast, the average life is about 6 hr. Die wear during a cast is negligible. The graphite dies are made in a machine shop adjacent to the main casting building; it is equipped with lathes, band-saws and drilling machines, all connected by ducting to a highly efficient dust-removal system. The throughput of metal for each die is from 100 to 800 lb/hr.; in the course of its lifetime the die may pass from 500 lb. to 15 tons of metal.

Machined Parts

As large sections of the engineering industry prefer to buy fully machined parts, a well-equipped machine shop has been installed for the production of finished bushes, bearings, washers, valve guides and so on.

In the planning for the new Encon plant, provision was made for additional expansion in the future, and adequate scope has been allowed for increasing production should the demand arise.

Flash Annealing Aluminium Sheet

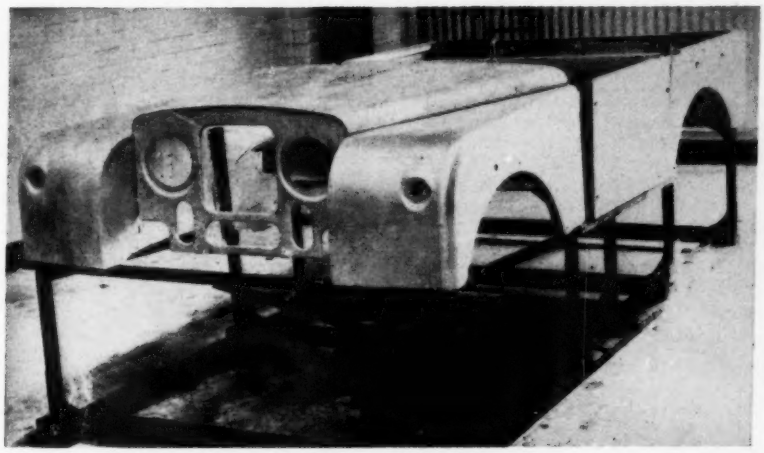
WORKING in conjunction with the Birmetals Sendzimir mill described in METAL INDUSTRY, 21 October, 1960, pp. 335, 355, is a flash annealing furnace taking sheets up to 8 ft. wide, or two 4 ft. wide sheets, side by side. This equipment was manufactured by G.W.B. Furnaces Limited, of Dudley, Worcs. The furnace has four heating zones, totalling 600 kW, the temperature range being 150°-550° C.

The furnace is designed to give a throughput of 2 ton/hr., but figures in excess of this have been achieved.

At the loading end of the furnace (see illustration) a series of rectangular section rubberized balata ropes are provided so as to ensure that the sheets are not marked during loading on the conveyor. The sheets are then automatically transferred to the furnace and cooling chamber conveyor. At the exit from the cooling chamber, the strips are once again passed on to a rubberized balata band conveyor, from which they are taken by hand by the furnace operators.

Aluminium Alloys For Deep Drawing

By C. J. SMITH A.I.M.
(*Technical Director, Birmetals Ltd.*)
(*concluded from* METAL INDUSTRY, 23 *June* 1961)



"Mock-up" of Land Rover pressings in Birmabright BB2 alloy

THE importance of grain size control has already been mentioned in connection with the stretcher-strain phenomenon and in relation to the avoidance of orange peel effects. As in other metals, low critical strains can give rise to severe grain growth even at normal annealing temperatures, whilst very severe reductions, followed by annealing at about 600°C. under slow rates of heating, may give rise to secondary recrystallization. The latter is hardly likely to occur in good mill practice or in the press shop; the former must always be carefully guarded against in both places. A diagrammatic representation of these effects for pure aluminium, according to Chevigny,[34] is given in Fig. 17. The tolerable range of safe conditions is much wider in the alloys than in the near pure grades of sheet and the aluminium - magnesium alloys of moderate content are particularly accommodating in this respect.

Final grain size is primarily controlled by the later reduction and annealing treatments. In the aluminium - manganese system, however, composition has a significant controlling influence, and the hot rolling conditions may also be vital.[35]

Microscope methods of measurement and counting offer the most accurate way of determining the grain size. Various standard systems, having more or less accuracy, can be employed according to the time available for counting. With the aid of electrolytic polishing and etching, quite rapid preparation and comparative assessment may be achieved on a routine basis for shop control, starting with samples in the as-rolled condition. Among other less precise, yet quite useful shop control methods, is the use of macro-etched sheet offcuts or the observation of the surface of the dome of an Erichsen test sample stressed just short of failure.

Directionality and the Earing Phenomenon. The earing phenomenon in deep drawn pressings is well known and needs no description.[36] If material is properly controlled as to earing behaviour it can contribute appreciably to economies in the press shop even on otherwise well-formed products. If it is uncontrolled to the extent that deep ears develop, these can aggravate other effects and cause, for example, premature tearing in the die entry region. The possible positions for ears in aluminium and its alloys have been described in the literature.[9,27]

A typical control test for earing tendency involves the drawing, under carefully stipulated conditions, of cylindrical cups from samples of sheet selected in a known direction relative to that of final rolling.

In one such test, the heights of all ears and troughs may be measured and arranged so that a numerical value may be expressed for the earing factor, a suitable constant being introduced to take care of the test conditions and the sheet thickness.

A typical formula adopted is:

$$\frac{he-ht}{ht-K}\times 100 \text{ earing units}$$

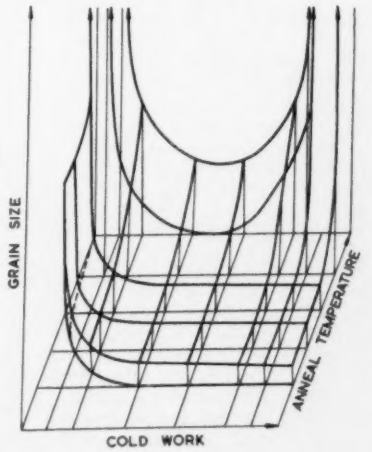
where he = average height of ears
ht = average height of troughs
K = constant for tools and gauge.

There is a tremendous amount of information in the literature which purports to a relationship in aluminium between almost every production factor and earing behaviour. However, the dominant factor is, perhaps, the composition. While minor earing effects are not unknown in the alloys, it is probably true to say that it is generally not a serious problem other than in the various grades of pure aluminium and here the influence of the minor elements plays a very important role. For instance, the silicon content in pure aluminium, and particularly the iron : silicon ratio, can affect both the direction and degree of earing. The level of silicon has also been stated to be of importance in regulating the earing behaviour of the Al-Mg-Si alloys. This is not surprising since, according to the level of this element and the amount of minor impurities, the silicon can exist in the form of Mg_2Si, as excess free silicon or as Al-Fe-Si and Al-Mn-Si compounds.

The aluminium-magnesium and the aluminium-manganese groups of alloys rarely present earing troubles in practice and thus find significant favour for all presswork operations; the aluminium - manganese alloys and the aluminium-magnesium alloy, containing about 0·5 per cent magnesium, are also favourites for spinning. The method of casting, pre-heating of slab, hot rolling temperature and reductions, inter-annealing practice and positions of anneal, cold rolling reductions and stages, final annealing and final rolling technique, have all been found to have greater or less effect on the degree of earing in pure aluminium and, to a very much less extent, in the alloys.

An extensive description of the effect of the various factors has been given by Thorley and Tucker,[27] which need not be repeated here. They give details of those factors which have been found to have influence towards 90° earing and those which have influence towards 45° earing; they also cite those

Fig. 17—Diagrammatic representation of typical relationships between cold work, grain size and annealing temperature for pure aluminium (after Chevigny)



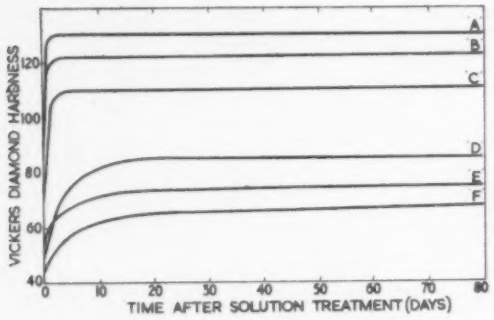


Fig. 18—Graph showing different rate of natural age-hardening for various alloys

A—Aluminium - copper - magnesium - silicon-manganese alloy HS 15 type. B—Aluminium - copper - magnesium - silicon-manganese alloy HS 14 type. C — Aluminium - magnesium - silicon-alloy + 2 per cent copper. D—Aluminium-zinc-magnesium medium strength alloy. E—Aluminium-magnesium-silicon alloy HS 30 type. F—Aluminium-magnesium-silicon alloy HS 20 type

factors which give no general change in direction but a reduction or increase in the size of ears of one type or the other. This and other similar work, particularly detailed experiments carried out by German workers,[37] are very extensive in their scope, but it is difficult to obtain from them the best practice for curing a particular problem in production. This is, no doubt, because many of the recommendations given, although scientifically correct, have practical or economic difficulties which do not allow them to be applied. It is probably true to say that each factory producing aluminium sheet has adopted its own individual technique by modification of different stages of the process,[25] and there is no universally preferred method for production of non-earing quality sheet.

Susceptibility to Heat-Treatment. The significant property of the heat-treatable aluminium alloys is that they can be brought into a relatively soft condition suitable for many forming operations by subjection to a solution heat-treatment at temperatures generally in the range of 480°-540°C., according to composition, and that they may be strengthened later as a result of precipitation processes. All heat-treatable alloys show some measure of spontaneous natural age-hardening whereby substantially stable properties are attained after a certain period of time.

A comparison of the natural age-hardening rates of certain alloys after quenching from normal solution treatment temperature is given in Fig. 18. It will be seen that those alloys containing copper as the principal alloying element have strong natural age-hardening characteristics and should be formed soon after quenching, whereas there will obviously be a much greater time allowance for working operations in the case of the alloys based on magnesium and silicon as the major hardening elements. In this latter group there is a distinct difference in behaviour according to the Mg:Si ratio.

A range of medium strength alloys, based on the Al-Zn-Mg system and having the alloying elements in quite different proportions from the high strength alloy D.T.D.687a used in aircraft practice, is now attracting considerable attention, because such materials exhibit a useful degree of age-hardening, and also show low sensitivity to variation in quenching conditions, moreover exhibiting attractive medium strength properties.[38-42]

The spontaneous hardening which occurs at room temperature can be virtually inhibited by storage at sub-zero temperatures, a practice which has been used in some press shops so as to avoid the need for several heat-treatment operations and thus obtain more efficient production. Such practice may be adopted even for those alloys with the strongest natural age-hardening characteristics. For some pressings, it is advisable, however, in order to gain the advantages of extra ductility and lower initial strength, that these alloys be used in the soft annealed condition.

Although the medium strength alloys of the Al-Mg-Si group will develop stable soft properties on annealing at temperatures of the order of 340°-380°C. with almost any conditions of cooling, high strength copper-bearing and zinc-bearing alloys are somewhat more sensitive to temperature and cooling effects, hence it is usual to adopt a so-called "super-annealing" technique. The material is soaked for a suitable time at a temperature which ensures full recrystallization without significant grain growth, and is then cooled down slowly in the furnace at a rate lower than that required to induce quench sensitivity in the alloy, thus suppressing solution treatment effects entirely. A typical treatment is to anneal at about 380°-420°C., followed by cooling at not more than 10°C. per hour until a temperature of about 200°C. has been reached. From this point, the alloy can then be cooled rapidly if required. Such treatments produce the softest and most stable properties.

Where the best attainable strength is to be finally developed in heat-treatable alloy components, it is more usual to employ furnace precipitation at temperatures in the range of 130°-200°C., according to alloy, than to use the natural ageing process. In the highest strength alloys, the precise choice of precipitation treatment may require to be related to composition because of the significance of the effect on such important properties of the material as corrosion resistance.

Surface Finish and Gauge Accuracy. Opinion is not unanimous on whether a fully bright or slightly matte surface is the more desirable for the production of light alloy pressings, and preference may be dictated largely by experience with particular press equipment and components. There is, however, a greater measure of agreement that significant variations in surface quality are undesirable in the same delivery of sheets. The texture of the surface obtained is characteristic of the alloy being rolled, the rolling reduction obtained, the type of lubricant employed and, in the case of soft materials, the conditions of annealing. Modern practice calls for some method of control of each of these variables. Recently, the role of lubricants has received special study in relation to rollability and cleanliness of annealing.[43,44]

Mention has already been made of the need for close gauge control in the production of temper rolled sheet and of controlled grain size materials where the precision of the final reductions is quite critical to success. Hand micrometers are still used in single sheet rolling, in which practice multi-pass light final reductions with frequent measurements are essential for obtaining satisfactory results, particularly on the widest sheets. However, an increasing number of strip mills have automatic measuring devices of the electronic type, usually employing beta-radiation as the sensing medium. Such devices need to be of robust construction and positioned so that they measure strip which is as free as possible from surface oil contamination. Automatic gauge control is not yet being widely adopted commercially, for although it is possible to feed back signals rapidly from the sensing medium into the apparatus controlling the rolling gap, problems still remain in translating this on all mills into a rapid and effective change of thickness.[45] Since strip of precise gauge is so obviously desirable for many processes there is considerable optimism that these difficulties will be surmounted.

Routine Check Testing and Inspection. Whatever the product found most suitable for pressing, regular and systematic inspection and testing are essential to proper control of quality if it is to perform consistently. Limits of permissible variation of a material can often be established during the tool try-out and pilot manufacturing stages, but in some instances it is only possible to obtain a true appreciation of possible difficulties when full production commences.

The purpose of a British Standard is to enable both manufacturer and purchaser to recognize a minimum quality standard for a particular class of material. Such standards are essentially documents arrived at by compromise, however, and in doing so the interests of many producers and many users have to be taken into account. Specifications of this nature, which are also written by Government departments responsible for the inspection of their own purchased materials, have the advantage that within one overall bracket there is sufficient latitude for

the various producers to employ those more precise controls of composition, temper and dimension which will suit the special requirements of their individual customers as well as satisfying their own manufacturing processes. This may, at first sight, seem to be a negation of standardization, but in practice a multiplicity of individual specification documents leads to confusion and the present arrangement works quite satisfactorily. It promotes a healthy situation in that it permits the best material to be supplied for a particular job and also fosters the competitive spirit on which industry relies to stimulate its progress.

At the finished stage, apart from the purely visual and dimensional inspections, it is usually arranged to select representative samples for mechanical or physical tests. The exact tests called for will be related not only to specified requirements of a Standard but, in many instances, to the manufacturer's knowledge of the hidden pitfalls in the job. The testing of finished sheet should, nevertheless, not preclude check testing at intermediate stages of manufacture. All light alloy producers have been educated on the A.I.D. control system,[46] which governs the inspection of aircraft materials, and it will be found that, in the main, their meticulous laboratory and inspection controls are based on the excellent tenets of this particular method of quality control, although it is natural that for "commercial" business each producer will have his own modifications of this system, which may demand, indeed, much tighter tolerances in his control procedures than for many non-commercial orders.

The rate of testing has to be carefully related to the rate of production and to the expected uniformity of the process. This is nowhere better illustrated than in the two examples of chemical analysis of the original melts and in mechanical testing of continuously annealed products. Effects of the unavoidable variations in processing must be taken into consideration, too, and as an example of this may be cited the need to ensure that off-gauge strip at the beginning and end of continuously rolled coils is properly excluded from deliveries.

Individual tests and their relevance to manufacturing processes and material behaviour have already been dealt with earlier. It is sufficient merely to state that each job requires its separate study so that the proper quantity and types of tests are applied at the appropriate stages of sheet production.

It is clear that the technology of pressing is not yet sufficiently advanced that a tool designer, with little practical experience, can look at a table of data for aluminium alloys and select immediately with certainty the material and precise method to be adopted for the manufacture of any component put before him. This happy situation may one day materialize, but in the meantime, how can both sheet manufacturer and consumer be of the greatest help to one another?

First, it has been indicated that sheet producers have their methods constantly under review to assess whether more uniform behaviour of material can be secured. Their own test methods cannot tell them all the answers, unfortunately.

Secondly, as users are becoming more experienced in pressing and drawing light alloys, they are being increasingly acquainted with the significant effects their own process factors can contribute to the final result. With the wider introduction of technically trained staff into the press shop, one finds a greater willingness to investigate problems in the shop first, before rushing off to the metal supplier, often with a very garbled version of what has gone wrong and accompanied by too few concrete facts and examples.

A supplier will always wish to hear even bad news, however, rather than to hear nothing and to find his orders have gone elsewhere, and if wise will seek to maintain fairly regular technical liaison with at least those customers whom he is aware have difficult, unusual or new pressings to make. With the growth of technical education at all levels, consultation between metal suppliers and users at an early stage of design, leading to examination of possible materials at the tool try-out stage so that matters are more or less finalized before bulk production commences, is becoming much more usual. This procedure is to the benefit of both parties; it improves relations not only in the immediate field, but usually in other fields, too. It should be stressed, however, that an ideal consultation with the material specialist should include the metallurgist, the designer, the production engineer and last, but by no means least, the press shop supervisor, who usually has most valuable practical knowledge.

Given this co-operation and access to the problems as they arise on the shop floor, it can be broadly stated that if a component can be produced by deep drawing or pressing it can be made in one of the aluminium-base materials, but that this may call for some re-design of tooling compared with what may be orthodox for steels and will also need careful consideration in the choice of material, must be appreciated at all levels from the very outset.

This field is still wide open for further research as has been suggested already. Both processing and material factors are far from precisely defined in several respects. Testing methods, too, could profit from further examination. It is not easy to design experiments which yield sufficient useful information of a practical nature when all these factors are combined, and there is a great temptation to oversimplify. Aluminium-base materials have received considerably less attention than steels so far in this type of work, and it is suggested that, in particular, the study of factors affecting anisotropy may be rewarding.

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Rolling Titanium Alloys

A METHOD has been developed at the Royal Aircraft Establishment for rolling titanium base alloys where the Young's modulus/specific gravity ratio (specific elastic modulus) has been increased by the addition of alloying elements such as carbon or boron, which form a stiff second phase in the alloys. Such additions make it impracticable to roll the alloys to sheet in a conventional manner.

The method consists, according to the *N.R.D.C. Bulletin*, in cladding a workpiece of the alloy with relatively thin sheets or plates of ductile titanium or titanium alloy which will combine with the base alloy, the cladding being welded initially to the workpiece at the edges, preferably by an inert gas arc welding process. The clad workpiece is then hot rolled with the cladding presented to the rolls.

Obituary

Mr. G. H. Alexander

WE regret to record the death of Mr. George Henry Alexander, founder of the firm of George H. Alexander Machinery Ltd. He was chairman and managing director up to the age of 91, and until 1946 was an active director of Wellworthy Ltd., another company which he helped to form.

MEN and Metals

It is reported that **Mr. H. R. Brooker** has been appointed a director and a joint managing director of Johnson, Matthey and Company Limited. He was formerly general sales manager.

An announcement from British Insulated Callender's Cables Limited gives news of the appointment of **Mr. D. I. S. Hinton,** B.A., as sales manager of BICC-Burndy Limited.

Recent news from Electro-Chemical Engineering Company Limited is to

the effect that **Mr. J. E. Entwistle** has been made a director of the company. He joined the company in 1954.

Chairman and managing director of each of the operating companies in the Baird and Tatlock group, **Mr. J. E. C. Bailey,** C.B.E., has been appointed to the board of Derbyshire Stone Limited.

Joining the company in 1952 as chief engineer of the transformer department, **Mr. R. W. Flux,** A.M.C.T., M.I.E.E., has been appointed to the board of Bruce Peebles and Company Limited.

Appointed sales manager of Great Lakes Carbon International Limited, **Mr. Cyril G. Conway** will have as his main responsibility the administration and extension, in this country and Europe, of the sales of the graphite and carbon products manufactured by Anglo Great Lakes Corporation Ltd., of Newcastle upon Tyne, and Great Lakes Carbon Corporation of New York.

Taking up an appointment with W. and C. Spicer Limited, makers of machinable and castable refractories, **Mr. T. E. Gray** was formerly with the Lafarge Aluminous Cement Company Limited.

A new division of Associated Electrical Industries Limited has been formed to manage the company's home district offices. **Mr. V. S. Riscoe,** M.B.E., B.Sc., M.I.E.E., has been appointed general manager of this new division and will take up full time duty on August 1 next.

Other appointments announced by Associated Electrical Industries Ltd. are as follows:—**Mr. A. T. Stretton,** A.M.I.Mech.E., A.M.I.E.E., to be assistant manager of the small industrial machines engineering department, Birmingham; **Mr. T. W. Haycroft,** A.M.I.Mar.E., has been appointed assistant education manager, craft apprenticeships, at Associated Electrical Industries (Manchester) Limited.

The retirement is announced of **Mr. A. T. Wilford,** B.Sc., A.R.C.S., F.R.I.C., from his position as director of research, London Transport. Mr. Wilford became superintendent of laboratories when the laboratory services of the London Transport Executive were centralized in January 1949, and in May 1950 he was appointed to the new post of director of research.

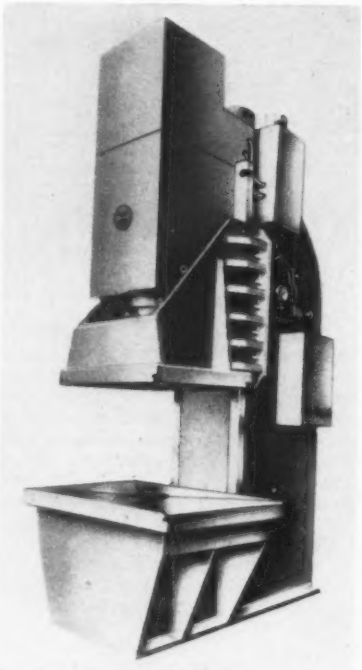
At the recently held meeting of the International Wrought Non-Ferrous Metals Council in Biarritz, **Dr. A. de Meuron,** of Switzerland, was elected chairman for the coming two years, and **Mr. G. Desbriere,** of France, was elected a vice-chairman.

Production director of Geo. Salter and Company Limited, **Mr. P. P. C. Drabble** is leaving the company at the end of July in order to take up a literary career.

Press Forming

OF Italian design and manufacture, the OMF-Ferralba "Delta" type open gap press has a capacity of 250 tons, with a table surface of approximately 51 in × 40 in. and a stroke of 39⅜ in. Operating speed is 15 strokes/min. It is now available in this country through the sole distributors, Rushworth & Co. (Sowerby Bridge) Ltd.

A 15 h.p. motor direct coupled to a multi-piston pump operates the hydraulic system, which is provided with an automatic valve for quick filling and discharging of the cylinder during idle strokes and also with an adjustable slide stopping device. Control is either by push buttons mounted on the side of the upright, which operate a servomotor or by a manual control lever. The slide can also be controlled by means of push buttons on a pendant in front of the machine.



The maximum tonnage is exerted throughout the entire stroke and thus the necessity of vertical die adjustment is eliminated. A special feature of the design of the press is its delta shape, which gives exceptionally good accessibility to the table and greatly facilitates the handling of bulky workpieces. High precision has been ensured by the provision of large surfaces for both pistons and slides, which by reducing friction minimize wear on these working parts. The slides are protected by a steel guard.

An interesting optional ancillary available for operation with this machine is an all-steel press brake attachment which provides a maximum folding length of 9 ft. 10 in. Other optional extras are ejectors and a blank-holder under the table.

A smaller version of the same machine has a capacity of 150 tons and a table surface of 41 in × 29 in. with a stroke of 27⅝ in. Speed of operation of this unit is 25 strokes/min. The folding attachment for this model has a maximum length of 6 ft. 7 in.

Rare Gases

DESCRIBING the applications of the rare gases—argon, helium, krypton, neon and xenon — a booklet entitled "Rare Gases, Science, Industry", has been produced by La Société l'Air Liquide, and is available in this country from Oxyton Ltd., 46 St. James's Place, London, S.W.1. Elaborately produced, it outlines very briefly the properties of the rare gases and indicates why they are of value in their particular field. It discusses the efficiency of an inert atmosphere, the progress in illumination since the invention of the luminescent tube, and ways in which rare gases have aided extremely low temperature analysis and research.

Industrial News *Home and Overseas*

Corrosion Summer School

Advance notice is given by the **Battersea College of Technology** (Metallurgy Department) of the eighth corrosion summer school, which is to be held from September 25 to 28 next. The school is organized with the co-operation of the Corrosion Group of the Society of Chemical Industry, and the subject this time is "Corrosion Problems in the Electrical Power Industry".

For the first time, the school is concerned with the particular aspects of corrosion met in one industry. Starting with boiler feedwater, corrosion and its prevention are surveyed as they affect each stage of generation, concluding with transmission and distribution.

The fee for the course is £10. Enrolment forms and further information may be obtained from the secretary (Metallurgy Courses), Battersea College of Technology, London, S.W.11.

Aluminium Plant for Venezuela

According to news from California, the Kaiser Aluminum and Chemical Corporation and a group of investors in Venezuela have organized a new company, Aluminio Nacional S.A. (ALNASA), to establish the first aluminium foil production plant in Venezuela.

The company will build a plant at Guacara, 100 miles west of Caracas, and begin operations late this year producing foil for tobacco, food packaging and labels. Kaiser Aluminum will hold a 26 per cent interest in the venture and will supply both aluminium sheet and the technical assistance required for the operation of the plant.

Non-Ferrous Club

Once again, the **Non-Ferrous Club** chose Stratford-upon-Avon Golf Course as the venue for the annual tournament of their Golfing Society, and again the weather proved perfect for the occasion. A record attendance—some 36 players and 60 for the dinner which followed—made the day a memorable one.

The morning round, a Stableford competition for the METAL INDUSTRY Bowl, was won jointly by Mr. G. Wallwork and Mr. E. Lisle. A tie also arose for second place, Mr. F. Aston and Mr. J. W. Corry sharing the honours. In the afternoon, a Greensome against Bogey for the Captain's Prize—a pair of folding garden chairs—the winning pair were Mr. J. Pettman and Mr. H. E. Mousir. The runners-up were Mr. H. Bailey and Mr. C. Weale.

A Works Visit

The Rogerstone Works of **Alcan Industries Limited** was chosen for the recent annual works visit of the Bristol and West of England Engineering Manufacturers' Association. The party of 50 spent the full day touring the plant, lunch being served at the King's Head Hotel, Newport. Producing aluminium and its alloys as plate, sheet, strip, extruded sections, tube, bar, rod and wire, and incorporating a large number of ancillary departments, the works offered a wide range of interests to an association embracing a great variety of trades in the field of engineering.

For most of the visitors, however, the main attraction was the 144 in. hot rolling mill, which was seen producing wide plate such as is used in ships' superstructures. Other hot-rolled plate was passed down the production line for further rolling into sheet products used variously for roofing, packaging, panelling, holloware and foil.

Of major interest to users of section and tube was the extrusion department, with its range of ten presses capable of turning out shapes in unlimited variety for use in most spheres of engineering, from the manufacture of window frames to the building of aircraft.

Wrought Metals Council

Delegates from the copper and copper alloy fabricating industries of 13 Western European countries were present when the General Assembly of the **International Wrought Non-Ferrous Metals Council** met in Biarritz, France, recently, under the chairmanship of Mr. W. Ertel, of Germany.

The past year has been one of remarkable achievement for the industry in member countries. Their production of copper and copper alloy semi-manufactures during the year ending on April 30, 1961, amounted to approximately 2,400,000 metric tons compared with 2,100,000 tons during the previous 12 months, an increase of 14 per cent. In recent years Western Europe has replaced the United States as the world's largest market for copper.

Supplies of copper and zinc have been adequate in the past 12 months. World production of refined copper amounted to about 4,900,000 metric tons during the year which ended on March 31, 1961, compared with 4,250,000 tons during the previous year. At the same time, United States consumption fell by some 150,000 tons. There have been no serious interruptions in copper supplies during the past year in spite of the political anxieties in Central Africa and a six weeks' strike at Chuquicamata mine in Chile.

The specialist committees of the International Council have been very busy during the past year.

In addition to the many statistics already collected, the Statistical Committee is now endeavouring to collect statistics of refined copper stocks in the hands of fabricators and of scrap metal intake by fabricators. More elaborate statistics of the end uses for copper and copper-alloy semi-manufactures are also under consideration.

The Technical Committee has produced a statistical report on accidents during 1960 and has carried out studies of eye protection and of the effect of age on the frequency of accidents. The same Committee has had great success in persuading the zinc producers to supply their zinc in palletized stacks. The copper producers have been slower to respond, but there are signs that they are now awakening to the need for handling economies. The Technical Committee has carried out a study of productive capacity for the manufacture of rolled copper and copper alloys and has continued its systematic programme of productivity surveys, which it has carried to a high pitch of refinement. The General Assembly decided that the Technical Committee should study problems of air and water pollution. In their efforts

A record attendance ensured the success of the Non-Ferrous Club's annual golf tournament at Stratford-upon-Avon on Tuesday, June 20. This group shows some of those attending the dinner at the Welcombe Hotel in the evening. In the front row (seated) are: Mr. R. L. Deutsch (Golf Secretary), Mr. P. Mould (Club's President) and Mr. H. T. Viney (Golf Captain).

to reduce these, fabricators are often involved in heavy expense.

The Substitution and Development Committee has made forecasts of the demand for copper and copper alloy products in 1964 and 1970. It is now considering a study of the competition between copper and aluminium for cables and a study of the market for copper in the electronics industry and in nuclear engineering.

A Working Party is studying problems of stock valuation for tax purposes. The Working Party is strongly of the opinion that fabricators should not be taxed on non-realizable profits arising from the price fluctuations of raw materials.

An inter-firm comparison of financial ratios has recently been completed by a second Working Party and further comparisons will be carried out in due course.

The General Assembly, which has striven for several years to promote faster progress towards international standards for copper and copper alloys, learned with interest that Technical Committee 26 of the International Standardisation Organisation is meeting on June 20-24 in Cologne. It is hoped that a substantial advance will be made, now that the Secretariat for this Committee is held by the German Standards Organisation. The International Council will be holding its next General Assembly in Vienna in June 1962.

Factory Heating

With the cost of space at prohibitive prices, it is important that every inch of factory space be made productive. **Johnson and Starley Limited** are offering their Continue-Flo line of horizontal suspended oil-fired warm air furnaces as a solution to this problem. Suspended from the roof, ceiling, or laid on top of girders, these furnaces utilize duct and range in output from 85,000 to 200,000 B.Th.U. per hour.

The primary heat exchanger is fabricated of Armco aluminized steel, which is said to be moisture resistant, capable of withstanding higher temperatures than mild steel, and has an extremely fast heat transfer. Embodying the down flow principle of heat travel, they are said to have a high efficiency and low stack loss. The unit is fired by a Continue-Flo pressure jet oil burner using 35 sec. fuel oil.

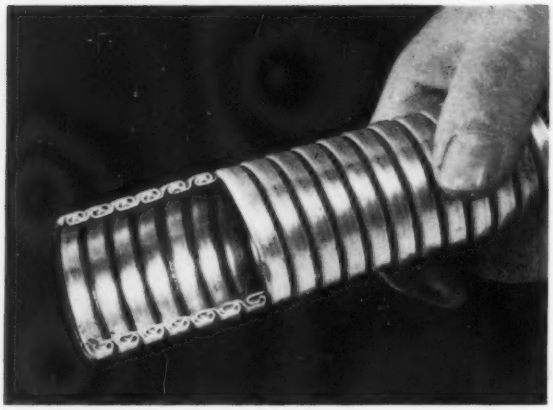
The furnaces are compact, completely assembled, and come with eyebolts for mounting. Enamelled in dawn grey and floral pink, the appearance of these furnaces makes them fit into all surroundings.

Flexible Aluminium Tubing

A recent development by the **United Flexible Metallic Tubing Co. Ltd.** is the manufacture of flexible tubing in aluminium alloy. For this product, aluminium strip is rolled and slit to fine tolerances and is then helically formed, by means of its interlocking edges, into tubing. A continuous sealing cord is introduced between the interlocking edges to maintain pressure tightness with flexibility.

The choice of a high strength alloy, Noral 54S (B.S.1470 NS5) offers a tube suitable for pressure service at about one-third the weight of similar tubing in other metals. This is proving of special interest in road-tanker and other bulk handling applications where hoses must often be man-handled. Working pressures range from 300 lb/in^2 for $\frac{3}{4}$ in. bore tubing to 75 lb/in^2 for 12 in. bore tubing.

The aluminium alloys, particularly the aluminium-magnesium type of which Noral 54S is in the higher strength range, are especially useful to industries handling or processing liquefied gases or other materials at very low temperatures, at which many other metals suffer embrittlement.



A partly-sectioned length of flexible metallic tubing which is now being made in aluminium by The United Flexible Metallic Tubing Co. Ltd. Hitherto, this type of tubing has only been available in galvanized steel, stainless steel and bronze

For the development of this new product, **Alcan Industries Limited** supplied all experimental material and technical advice on forming and fabrication techniques.

Lifting and Tipping Machine

Described as a simple and reliable machine for lifting and emptying all types of containers, a new unit has been introduced by **Russell Constructions Ltd.** This new machine will lift any kind of container weighing up to 10 cwt., and will tip it so as to empty the contents into a hopper, truck, mixer or other receptacle.

Known as the "Hi-Tip", this machine has a minimum height of lift of 4 ft. 6 in., and an interesting feature is that vertical sections can be added to increase this dimension to any height desired. The unit is fabricated of $\frac{1}{4}$ in. mild steel of all-welded construction and consists of a base, a top unit and centre sections. The base, which for the standard machine occupies an area of only 3 ft. by 4 ft. 6 in., houses the electrical equipment, control mechanism, main drive and chain compensating device, all the mechanical parts being adequately protected.

The top unit contains the actuating cam guides for the tipping action, and the centre sections include the appropriate lengths of guide rails. It is understood that this unit is suitable for continuous 24 hr. operation.

Agency Secured

News from **Aveley Electric Ltd.** is to the effect that they have been appointed sole U.K. agents for the Hudson Tool and Die Co. Inc., of Newark, New Jersey. This latter company are makers of drawn and pressed metal enclosures for electronic components. Over 1,600 different standard cans are available on stock or short delivery.

The 600 Group

A well produced and interesting folder has just been produced by **The George Cohen 600 Group Ltd.** in which is given an up-to-date outline of the scope of the many companies in the group. Details of the products and activities of these companies are indicated, and the folder should be of much help to those who conduct business with the group or intend to do so.

Autumn Conference

Early notice is given of the Autumn Conference of the **Institute of Physics and The Physical Society,** which will be held in London on November 17 and 18 this year. The subject of the conference is "Imperfections in Crystals", and the conference is sponsored by the X-ray Analysis Group of the institute and society.

Change of Address

As from Monday last, the new address of the **National Council for Technological Awards** is 24 Park Crescent, London, W.1, and the telephone number is Langham 4879.

Aluminium Consumption

Speaking to the delegates at the Light Metals Congress, held in Leoben last week, Mr. R. D. Hamer, the President of Alcan S.A., of Zurich, said that European aluminium consumption would increase from below 1·25 million tons in 1960 to at least 2·25 million tons within the decade. He estimated that European smelter capacity would be expanded from 870,000 tons to 1,500,000 tons in the same period. Europe's production deficit would, therefore, be at least 800,000 tons, compared with 410,000 in 1960.

To produce this additional amount in Europe would be extremely difficult in view of the Continent's shortage of power resources and ever-increasing need for electricity. The industry would be obliged to import substantial additional tonnages from outside Europe, Mr. Hamer said.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week fell 755 tons to 7,335 tons, comprising London 3,710, Liverpool 2,481, and Hull 1,144.

Copper stocks rose 625 tons to 18,052, distributed as follows:—London 600, Liverpool 14,527, Birmingham 50, Manchester 2,850, and Hull 25.

Lead duty-free stocks fell 275 tons to 7,800 tons, comprising London 7,471, Glasgow 4, and Swansea 325. In-bond stocks fell 25 tons to 3,743 tons (all in London).

Zinc duty-free stocks fell 161 tons to 4,395, comprising London 3,292, Glasgow

85, Manchester 450, and Liverpool 568. In-bond stocks rose 16 tons to 2,653 (all in London).

Non-Ferrous Metals for India

In recent news from Washington it is stated that the Development Loan Fund has announced approval of a 20 million dollar U.S. Government loan to the Indian Government for the procurement of aluminium, copper and zinc in the United States.

The non-ferrous metals were needed to meet the objectives of the first year of India's third five-year plan. Details of the loan agreement had still to be negotiated. Much of the metal was expected to be processed into its final form at privately owned plants in India.

Spanish Lead and Zinc

Spanish production of lead in May last totalled 6,164 metric tons, compared with 4,573 tons in April and 1,921 tons in May 1960, according to statistics issued by the Metal Syndicate. This brought total production during the first five months of this year to 24,827 tons. Production of zinc was 2,960 metric tons, compared with 3,108 tons in April and 2,011 tons in May 1960. Total output in the first five months of this year amounted to 14,119 tons.

Spark Erosion Machines

It is announced by the **Stedall Machine Tool Company** that they have been appointed by Impregnated Diamond Products Limited, distributors of their "Sparcatron" range of spark erosion machines, used extensively in the manufacture of press tools, forge dies, etc., and "Sparcard" tungsten carbide impregnating machines, for cutters, lathe tools, etc.

Japan Tests Australian Bauxite

News from Brisbane is to the effect that the Commonwealth Aluminium Corporation Pty. Ltd. has shipped 30,000 tons of bauxite from Weipa in the Gulf of Carpentaria to Japan for testing. The bauxite was exported in three separate trial shipments. Small ships took the ore to large Japanese cargo ships waiting in the open sea off Weipa. It is now under test with Japanese firms to determine the ore's processing behaviour.

Comalco is leading in the exploitation of bauxite deposits on Cape York. The firm is spending £45 million on a bauxite industry at Weipa, where it will reduce the ore to alumina ready for smelting to aluminium.

Sale of U S. Stockpile Rhodium

General Services Administration in Washington has announced that sealed bids would be received until next July 28 to buy 5,770 troy ounces of 99 per cent rhodium sponge and 219,257 troy ounces of 94·2 per cent rhodium powder.

These materials, declared surplus to United States Government stockpile needs, are used in electroplating as well as by the electrical manufacturing, chemical, petroleum and glass industries. "The minimum acceptance bid will be for the total of either of these two items for delivery f.o.b. their storage location in New York City", the G.S.A. announcement said.

New Offices Opened

On Monday last, the new head sales office and showroom in Villiers House, Strand, London, W.C.2, for **G. A. Harvey and Company (London) Ltd.** were officially opened by Mr. Paul Reilly, director of the Council of Industrial Design.

The new office and showroom are on the first floor of a modern office building and have an area of 6,500 ft². In the showroom are exhibited many items from the Harvey and Harvey-Milner ranges of steel office furniture and partitioning, while in the reception area are coloured transparencies showing examples of production from Harvey's other departments, which include heavy fabrication, light fabrication, sheet metalwork, metal perforation, wirework and weaving, and galvanizing.

The offices provide accommodation for senior personnel of the sales department, and also for the manager, sales representatives and staff of the London branch office.

The opening of this office and showroom in Villiers House, coupled with the chain of six new provincial offices, provides a notable milestone in the history of the company. From the humble beginnings of an old smithy shop in Lewisham in 1874, where Mr. George Alfred Harvey founded the firm with the help of one boy, the works, removed to Greenwich in 1913, now occupies an area of 28 acres. There are a further two acres at the Margate factory, and in all Harveys now have over 2,600 employees.

Tin Expansion Required

The urgent need today is not for a tin restriction scheme but for tin expansion, says **A. Strauss and Company Limited** in its June review. It is for that reason that the desirability is being canvassed in various quarters for a £1,000 price level. Only then, it is suggested, will there be sufficient inducement for the smaller Malayan producers who closed down when prices were lower and output was restricted, to re-start operating.

This has also been urged by Bolivia, whose National Commissioner of Mining Operations declared, when the market was at £880, that the cost of mining tin in his country was above the world price.

There are, however, a number of factors which may combine to retard a rapid price rise of such a dimension. During the days preceding the exhaustion of the Buffer Stock, many consumers availed themselves of the opportunity of covering a good part of their forward requirements while the going was good. To the extent that they succeeded, their purchases will be diminished during the coming weeks. There was also keen and heavy speculative buying which, no doubt, will be liquidated as soon as profitable opportunities present themselves.

At the moment, there is sufficient tin available to meet all consumers' needs. Indeed, the argument has been advanced that the continued availability of supplies at a time when consumption is running high raises doubts about our estimate that the shortfall between tin production and consumption would exceed 15,000 tons in the course of this year.

The review concludes that should a shortage crisis arise, stocks in the U.S., Malaya and the U.K. (apart from those in consumers' hands) could be further reduced, but the amount now available could not bear the reductions at the rate of the early months of this year for very long. Recourse to these supplies plainly in no way affects estimates of the deficit between anticipated production and consumption. These may, however, be marginally influenced if, as is probable, the backlog of Katanga production appears on the market later in the year.

Lead Applications

An interesting and informative booklet has just been issued by **Associated Lead Manufacturers Limited** on "Lead Applications to Modern Industry". This booklet is, in fact, the reprinting of a Paper by Mr. E. R. Newson, of the company, which was read at the European Conference for Chemical Technology (Achema Congress) 1961 and covers the use of lead in both the chemical industry and the nuclear field.

Copies of this Paper, which is well illustrated, can be obtained from the offices of the company, at Clements House, 14 Gresham Street, London, E.C.2.

Nuclear Power Contracts

A £300,000 contract for electrically-welded finned steel tube for the Dungeness nuclear power station has been received by the Tube Investments company, **Tube Products Limited.** This follows contracts for similar extended surface welded tubing, to a total value of over £2,000,000, placed with Tube Products for the Hunterston and Trawsfynydd nuclear power stations in the United Kingdom; the Latina project in Italy, and the Tokai-Mura project in Japan.

New Polishing Compound

Recently introduced by **Roto-Finish Limited,** "Universal White" has been especially developed to provide a white

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for April 1961 have been issued by the Aluminium Industry Council as follows (in long tons):—

Virgin Aluminium	
Production	2,836
Imports	17,989
Despatches to consumers	24,578
Secondary Aluminium	
Production	9,921
Virgin content of above	951
Despatches (including virgin content)	10,212
Scrap	
Arisings	12,440
Estimated quantity of metal recoverable	9,213
Consumption by:	
(a) Secondary smelters	11,066
(b) Other uses	991
Despatches of wrought and cast products	
Sheet, strip and circles	14,381
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	3,553
(b) Tubes (i) extruded	385
(ii) cold drawn	630
(iii) formed strip	—
(c) (i) Wire	1,719
(ii) Hot rolled rod (not included in (c) (i))	7
Forgings	351
Castings: (a) Sand	1,621
(b) Gravity die	4,056
(c) Pressure die	1,780
Foil	2,019
Paste	313

polishing composition with a universal application for polishing prior to decorative plating or for final lustre finishing and, it is said, can be used on most metals.

The compound has been prepared to withstand any powderization. The abrasive media contained is, we understand, of extremely fine grade with a strong and consistent coating power. Therefore, small quantities only should be applied to the mop, and a fast lustre can be produced with extremely fine micro finish.

A.D.A. Golf Meeting

At the Moor Hall Park Golf Club, on June 15, the **Aluminium Development Association** held its annual golf meeting and dinner, the hosts on this occasion being Birmid Industries Ltd. This year the prizes for the Horace Clarke Cup competition represented a departure from the usual. Play in the competition was of good standard and the winners were narrowly separated in the end.

Results:—Horace Clarke Cup—1, Mr. F. Whitworth, Sandwell Casting Co., net score 68; 2, Mr. J. H. Mayes, Alcan Industries Ltd., net score 69; 3, Mr. C. J. Midgley, J. Frankel (Aluminium) Ltd., net score 71.

Foursome Event (over 9 holes)—1, Whitworth and Meese (score 1-up, decided on first five holes; 2, Midgley and Millward (1 up); 3, Gentles and Jensen (all square).

Mr. G. W. Lacey, President of the association, presided at the dinner at Penn's Hall Hotel, Sutton Coldfield. Proposing a toast to "The Hosts", Mr. Lacey referred with pleasure to the return to health of **Mr. Edward Player,** Birmid Industries Ltd., and spoke warmly of his company's hospitality. He praised the goodwill which was engendered by such friendly meetings, and Mr. Player replied.

News from Birmingham

The number of unemployed in the Midlands dropped by a further 2,300 in the last month. The Ministry of Labour also announces that a rising demand for labour was reflected in an increase of nearly 3,000 in unfilled vacancies. With the figure of 18,495 unemployed, the Midland rate is now 0·8, as compared with the national average of 1·2. At the moment the motor industry in the area is suffering from an unfortunate strike at a works making components, and this threatens to bring thousands of workers to idleness unless a speedy settlement is reached. Apart from this, the industrial outlook shows little change, and most firms are more active than they were at the beginning of the year. Prospects are good for the second half.

There are signs that users of iron and steel are pruning orders as far as forward business is concerned. Many steel producers have reduced their order books considerably in the last few weeks. At the same time, capacity in the mills has been increased, and whereas a little time ago it took months to obtain delivery, the time lag has been reduced to weeks. There are big contracts for structural steel from building contractors. Iron foundries continue busy on heavy castings, but the makers of light castings could undertake more work without difficulty. Supplies of pig iron are adequate. The major part of the pig iron output consists of basic grade, which is quickly absorbed for steelmaking.

Parliamentary News

During the Committee Stage of the Finance Bill, the Chancellor of the Exchequer, Mr. Selwyn Lloyd, said that while he could make no promise, he would look again at the question of whether some further kind of tax concession could be made to help British tin producers.

He said it was common sense that we should attempt to get all the mineral wealth we could from beneath the surface of our own country. He had considered the matter carefully. He saw a deputation which visited him, and he had been thinking of ways in which it would be possible to help the industry. His difficulty was that it already got a substantial tax holiday.

The following were examples of the existing tax benefits. If the capital required for a new mine was, say, £500,000, of which £400,000 was put into mining works, it would carry an investment allowance of 20 per cent, and an initial allowance of 20 per cent. If a further £200,000 were put into plant and machinery, it would carry an investment allowance of 20 per cent and an initial allowance of 10 per cent. Before any tax would be paid, the total profit would have reached a figure of £140,000. In addition, there would be a tax-free bonus of £80,000 arising from the investment allowance.

His difficulty was that if he were to put forward any sort of further concession, it might be held to be a precedent for all extractive industries. But this was a special case and there were special circumstances in connection with tin at the present time. He could not make any promise, but he would look again at the matter before the Report Stage of the Finance Bill.

Tin Council Order.—In the Lords, the Under-Secretary of State for Foreign Affairs, the Marquess of Lansdowne, moving an Order to confer privileges and legal immunities on the International Tin Council, said it was required to enable the Government to ratify the second International Tin Agreement signed by the Government at London on November 3, 1960. The Council with which the Order dealt would be the successor of the first International Tin Council, which was established by the International Tin Agreement, 1954. That Agreement came into force on July 1, 1956. The duration of the 1954 Agreement was fixed at five years from the date of its entering into force, so that the Agreement was due to terminate on June 30 of this year and to be followed immediately by the second International Tin Agreement, which was due to become effective on July 1.

The first International Tin Council established its headquarters in London, and it had been agreed that the second Council should do the same. The choice of London for its headquarters was because the members of the Council regarded London as the centre of the international tin market. The new Council would continue the work of its predecessor and would enjoy exactly the same legal capacities and privileges. Article 2 of the Order would accord the Council the legal capacities possessed by an ordinary limited liability company, as, for instance, the power to own property, enter into contracts and appear in the courts. Article 3 would confer the fiscal privilege of exemption of the Council from United Kingdom tax on its premises or assets, or on profits, if any, accruing to it as a result of its dealings in tin. Those profits resulted from the Council's operation of the buffer stock of tin which it held to ensure reasonable stability in the international tin market. The Council would also enjoy relief from that portion of the local rates leviable on its premises which was devoted to services from which it derived no direct benefit, for instance, education, public baths and paupers' burials. It would not be granted the privilege of importing supplies without payment of customs duty.

Under Article 4, officers employed by the Council who were not citizens of the United Kingdom and Colonies would be exempt from income tax deductions on their official salaries. Five such persons were at present employed by the Council. The remaining eleven members of the secretariat were United Kingdom nationals who would receive no privileges under the Order. The number of officers employed might vary, but the size of the secretariat was not expected to alter when the new Council came into being. None of the officials of the secretariat would be accorded legal immunity. The only privileges accorded to them would be exemption with regard to United Kingdom income tax on the official salaries of the Council's employees who were not citizens of the United Kingdom and Colonies.

Lord Morrison asked why the Tin Council should be specifically exempted by the Order of the Government and of Parliament from paying taxes when every other capitalist organization in the United Kingdom, so far as it could not evade them, paid taxes. Regarding relief from local rates, he said that the Tin Council was going to employ people at its offices and some of those people would have benefited from education. It was monstrous that ratepayers should have to pay more because the Tin Council was to be the subject of privileges and immunities. The Order was approved without a division.

Company Reports

M. L. Alkan Ltd.

Interim dividend 7½ per cent (same) for year to September 30, 1961. Directors state that trading results to date have been well maintained compared with previous year.

A. Cohen and Co. Ltd.

Final dividend 16½ per cent, making 22½ per cent for 1960 (same). Group net profit £126,565 (£108,629), after tax £44,047 (£51,364). Attributable to Cohen £103,033 (£101,618). Dividend £41,344 (same).

Keith Blackman Ltd.

Dividend 17½ per cent year to March 31, 1961 (same). Profit £123,456 (£122,410), after tax £152,072 (£114,284), etc. Add transferred from pensions reserve nil (£20,000). To general reserve £50,000 (same). Forward £193,832 (£204,289).

Metal Market News

TIN MOVING UP AGAIN — COPPER REMAINS QUIET — LEAD AND ZINC SHOW INCREASES

LAST week was noteworthy for the startling developments on the tin market, where the announcement by the Tin Buffer Pool that its supplies of metal were exhausted, brought a dramatic rise in the quotation. On Tuesday, the turnover exceeded 5,000 tons, which constitutes a record, and as to the course of the price, it is very difficult to know what is going to happen. On the face of it, there would appear to be almost no limit to the extent of the rise. At the beginning of the week it was announced that L.M.E. warehouse stocks of tin were down by 644 tons to 8,090 tons and, presumably, much greater inroads will be made in due course. There are, of course, very large stocks of tin in Government hands in the United States, but whether pressure will be brought to bear on the authorities to release any part of this remains to be seen. In any case, it is thought that the official machinery for securing the freeing of some part of this reserve for industry is rather cumbersome and might take some months to effect a release. A four figure quotation for tin in Whittington Avenue certainly seems to be a possibility. It is understood that a meeting of the Tin Council was due to be held on June 28. There was talk, it will be remembered, of the £880 selling limit being revised upwards, but nothing transpired, and in the event it appeared that as the Buffer Stock manager was unable to supply metal the £880 barrier was broken, and to some purpose. The future is, of course, obscure, and some time may elapse before consumers find out just what is going to happen.

Stocks of copper in official L.M.E. warehouses staged a substantial rise at the beginning of last week, for the revised figure was up by 550 tons to 17,427, and on Tuesday the contango stood at £3 15s. 0d., which constitutes something of a record since the reopening of the copper futures market. Trading was very brisk in standard copper, and for the week the total turnover added up to 20,500 tons. Values fluctuated, and at one time cash was down to £230, but in mid-week there was a sudden turn round and the price rose by £5. Finally, the close on Friday afternoon was £235 5s. 0d. for cash, 25s. up on balance, and for three months £238 10s. 0d., which was £2 higher. The course of price movements was erratic, and it is not easy to forecast the future. It was said that speculators were getting out of copper and into tin, which offered such rosy prospects for a quick profit. It is, perhaps, not surprising that copper turned round so sharply at £230, for there are a number of uncertain factors still in existence apart from labour uncertainties in Chile and the United States. Consumer demand is hard to estimate, but there was doubtless some buying at the bottom of the market.

The uprush in the tin price last week took the quotation to the highest point since early 1953, thanks to last week's spectacular events. In total, the turnover last week amounted to some 9,700 tons, cash closing £59 10s. 0d. up at £939 10s. 0d., and three months £53 higher at £943. The week's turnover constituted a record. Inasmuch as not, by any means, all last week's buying was on consumer account, some profit taking must be expected, but eventually prices may well go considerably higher before the situation is adjusted. By comparison with tin, and even with copper, lead and zinc staged uneventful sessions, and in zinc the volume of trading was well below the average at 3,500 tons. This metal closed at £78 for cash and £79 for three months, both positions being 5s. up on balance. In lead, conditions were more active, some 8,600 tons changing hands with a gain of 22s. 6d. in both cash and three months. Closing prices were £65 5s. 0d. and £66 10s. 0d.

New York

Copper futures, after an early modest decline, steadied later on covering. Physical copper was quiet among dealers, spotty among custom smelters, and little changed in the producer sector. Informed sources said that blister copper shipments from Chile were being affected by the maritime strike and holding up the refining of copper. Tin was softer and quiet. Lead was quiet. Zinc was moderately active. Scrap copper was steady and quiet. Lead scrap was quiet. Zinc scrap was modestly active.

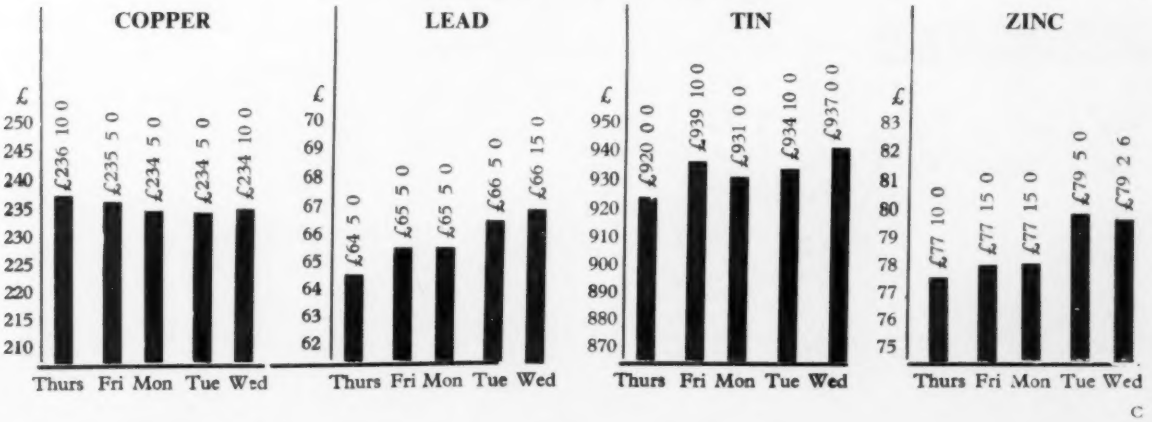
Congressional sources in Washington say the Kennedy Administration has suggested a plan to help the depressed lead and zinc mining industry. A key part of the plan would authorize the Agriculture Department to sell certain surplus farm commodities to foreign lands for dollars that would be used to purchase domestic lead and zinc for a supplemental Government stockpile. It was stated that $60,000,000 of the metals could be purchased this way.

In addition, the Administration proposal is said to hint at the removal of the ceiling on silver prices. A number of lead and zinc producers also mine silver, and it is believed the removal of the ceiling on silver would partly offset the losses they are suffering from the lead and zinc slump.

Domestic consumption of copper by brass and wire mills and foundries based on their shipments of fabricated products in May last totalled 145,804 short tons, compared with 120,676 tons in the previous month.

London Metal Exchange

Thursday 22 June to Wednesday 28 June 1961



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NON-FERROUS

PRIMARY METALS

All prices quoted are those available at 2 p.m. 28/6/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	„	237	10	0
Antimony Metal 99%	„	230	0	0
Antimony Oxide				
Commercial	„	194	10	0
Antimony White Oxide	„	212	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		11	0
Calcium	„	2	0	0
Cerium 99%	„	15	0	0
Chromium	„		6	11
Cobalt	„		12	0
Columbite per unit			8	10
Copper H.C. Electro	ton	234	10	0
Fire Refined 99·70%	„	233	0	0
Fire Refined 99·50%	„	232	0	0

		£	s.	d.
Copper Sulphate	ton	79	10	0
Germanium	grm.		—	
Gold	oz.	12	11	4½
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	66	15	0
Magnesium Ingots	lb.			
99·8%	„		2	2½
99·9+%	„		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		5	6
Alloy Ingot, AZ91X		1	11½-2	1¼
Manganese Metal	ton	280	0	0
Mercury	flask	67	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.	20	0	0
Osmiridium	„		—	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	„	30	5	0
Rhodium	„	46	0	0
Ruthenium	„	16	0	0
Selenium	lb.	2	6	6
Silicon 98%	ton	123	0	0
Silver Spot Bars	oz.		6	7⅛
Tellurium Sticks	lb.	2	0	0
Tin	ton	937	0	0
*Zinc				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	79	13	9
Dust 95/97%	„	125	0	0
Dust 98/99%	„	131	0	0
Granulated 99+%	„	104	13	9
Granulated 99·99+%	„	117	1	3

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

All prices quoted are those available at 2 p.m. 28/6/61

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0
Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	155	0	0
B.S. 1490 L.M.2	„	157	0	0
B.S. 1490 L.M.4	„	164	0	0
B.S. 1490 L.M.6	„	176	0	0
***Aluminium Bronze**				
BSS 1400 AB.1	ton	251	0	0
BSS 1400 AB.2	„	258	0	0

		£	s.	d.
***Brass**				
BSS 1400-B3 65/35	ton	180	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„	228	0	0
***Gunmetal**				
R.C.H. 3/4% ton	„		—	
(85/5/5/5) LG2	„	223	0	0
(86/7/5/2) LG3	„	233	0	0
(88/10/2/1)	„	293	0	0
(88/10/2/½)	„	303	0	0
***Manganese Bronze**				
BSS 1400 HTB1	„	197	0	0
BSS 1400 HTB2	„	215	0	0
BSS 1400 HTB3	„	233	0	0
Nickel Silver				
Casting Quality 12%	„	260	0	0
„ „ 16%	„	270	0	0
„ „ 18%	„	310	0	0
***Phosphor Bronze**				
B.S.1400P.B.1.(A.I.D. released)	„	319	0	0
B.S. 1400 L.P.B.1	„	247	0	0

**Average prices for the last week-end.*

Phosphor Copper		£	s.	d.
10%	ton	264	0	0
15%	„	267	0	0
Phosphor Tin				
5%	„	985	0	0
Silicon Bronze				
BSS 1400-SB1	„	293	0	0
Solder, soft, BSS 219				
Grade C Tinmans	„	418	5	0
Grade D Plumbers	„	332	0	0
Grade M	„	461	5	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
BSS 1004 Alloy A	ton	110	11	3
BSS 1004 Alloy B	„	114	11	3
Sodium-Zinc	lb.		2	6½

SCRAP METALS

Merchants' average buying prices delivered, per ton, 27/6/61

Aluminium	£
New Cuttings	137
Old Rolled	104
Segregated Turnings	79
Brass	
Cuttings	164
Rod Ends	147
Heavy Yellow	140
Light	135
Rolled	150
Collected Scrap	136
Turnings	140

Copper	£
Wire	211
Firebox, cut up	209
Heavy	208
Light	204
Cuttings	216
Turnings	190
Braziery	173
Gunmetal	
Gear Wheels	203
Admiralty	203
Commercial	188
Turnings	183

Lead	£
Scrap	55
Nickel	
Cuttings	—
Anodes	554
Phosphor Bronze	
Scrap	188
Turnings	183
Zinc	
Remelted	70
Cuttings	63
Old Zinc	43

METAL PRICES

SEMI-FABRICATED PRODUCTS

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products

	£ s. d.
Aluminium	
Sheet 10 S.W.G. lb.	2 10½
Sheet 18 S.W.G. „	3 0½
Sheet 24 S.W.G. „	3 3½
Strip 10 S.W.G. „	2 10½
Strip 18 S.W.G. „	2 11½
Strip 24 S.W.G. „	3 1
Circles 22 S.W.G. „	3 4½
Circles 18 S.W.G. „	3 3½
Circles 12 S.W.G. „	3 2½
Plate as rolled „	2 10
Sections „	3 4
Wire 10 S.W.G. „	3 1½
Tubes 1 in. o.d.	
16 S.W.G. „	4 4
Aluminium Alloys	
BS 1470. HS19W.	
Sheet 10 S.W.G. „	3 3
Sheet 18 S.W.G. „	3 5½
Sheet 24 S.W.G. „	4 1
Strip 10 S.W.G. „	3 3
Strip 18 S.W.G. „	3 4½
Strip 24 S.W.G. „	4 0½
BS1477. HP30M.	
Plate as rolled „	3 1
BS1470. HC15WP.	
Sheet 10 S.W.G. „	4 3
Sheet 18 S.W.G. „	4 8½
Sheet 24 S.W.G. „	5 8½
Strip 10 S.W.G. „	4 4
Strip 18 S.W.G. „	4 8½
Strip 24 S.W.G. „	5 4½

	£ s. d.
Aluminium Alloys—cont.	
BS1477. HPC15WP.	
Plate heat treated lb.	3 10½
BS1475. HG19W.	
Wire 10 S.W.G. „	4 2
BS1471. HT19WP.	
Tubes 1 in. o.d.	
16 S.W.G. „	5 5
BS1476. HE19WP.	
Sections „	3 4
Split tube	
19 S.W.G. (¼″) „	4 2
20 S.W.G. (⅜″) „	3 11
21 S.W.G. (½″) „	4 1
22 S.W.G. (¼″) „	4 11
Welded tube	
14 to 20 S.W.G.	
(sizes ½″ to 1¼″) „	3/10½ to 5/8½
Brass	
Tubes lb.	1 10½
Brazed Tubes „	3 3½
Drawn Strip Sections „	3 3½
Sheet ton	202 10 0
Strip „	202 10 0
Extruded Bar lb.	2 0½
Condenser Plate (Yellow Metal) ton	192 0 0
Condenser Plate (Naval Brass) „	205 0 0
Wire lb.	2 8⅞

	£ s. d.
Beryllium Copper	
Strip lb.	1 4 11
Rod „	1 1 6
Wire „	1 4 9
Copper	
Tubes lb.	2 4½
Sheet ton	270 5 0
Strip „	270 5 0
H.C. Wire „	287 15 0
Cupro Nickel	
Tubes 70/30 lb.	3 7
Lead	
Pipes (London) ton	107 0 0
Sheet (London) „	104 15 0
Tellurium Lead „	£6 extra
Nickel Silver	
Sheet and Strip 10% lb.	3 11
Wire 10% „	4 4
Phosphor Bronze	
Wire „	4 2½
Titanium (1,000 lb. lots)	
Billet 4½″ to 18″ dia. lb.	47/- 48/-
Rod ¼″ to 4″ dia. „	85/- 53/-
Wire ·036″-232″ dia. „	159/- 99/-
Strip ·001″ to ·048″ „	350/- 68/-
Sheet 8′ × 2′. 20 gauge „	73/-
Tube, representative average gauge „	198/-
Extrusions „	90/-
Zinc	
Sheet ton	116 15 0
Strip „	nom.

FOREIGN QUOTATIONS

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

Belgium	fr/kg	£/ton
Copper: electrolytic	32.25	235 14
Tin	132.00	1034 15

Canada	c/lb	£/ton
Aluminium	26.00	210 12
Copper: electrolytic	30.00	243 0
Lead	10.00	81 0
Nickel	70.00	567 0
Zinc: Prime western	11.75	95 3
High grade 99.95	12.35	100 0
High grade 99.99	12.75	103 5

France	fr/kg	£/ton
Aluminium	2.43	179 11
Antimony 99·0	2.80	206 18
Cadmium	16.25	1,200 17
Copper: electrolytic	3.26	240 18
Lead	.95	70 4
Nickel	9.00	665 2
Tin	13.36	982 17
Zinc: Thermic	1.16	87 18
Zinc: electrolytic	1.24	91 12
Scrap		
Copper: electrolytic	2.92	215 14
Heavy copper	2.92	215 14
No. 1 copper wire	2 80	206 18
Brass rod ends	2.23	164 15
Zinc castings	.95	70 4
Lead	.88	65 0
Aluminium	1.70	125 12

Italy	lire/kg	£/ton
Aluminium	370	216 1
Antimony 99·0	520	303 13
Copper: wire bars 99.9	455	265 14
Lead	163	96 3
Nickel	1,180	689 2
Tin	1,720	1,004 9
Zinc: electrolytic	181	105 14
Scrap		
Aluminium soft sheet clippings (new)	305	178 2
Lead, soft, first quality	137	80 0
Lead, battery plates	77	45 19
Copper, first grade	380	221 18
Bronze, commercial gunmetal	360	221 4
Brass: heavy	280	163 10
Brass: light	265	155 15
Brass, bar turnings	280	163 10
Old zinc	105	61 6

Switzerland	fr/kg	£/ton
Aluminium	2.50	210 5
Copper: electrolytic	3.05	256 10
Lead	.85	71 9
Nickel	7.50	630 15
Tin	10.77	905 15
Zinc: High grade 99.99	1.10	92 10

Japan	Yen per metric ton
Scrap	
Copper: electrolytic	303,000
Copper wire No. 1	281,000
Copper wire No. 2	268,000
Heavy copper	268,000
Light copper	237,000
Brass, new cuttings	208,000
Red brass scrap	215,000

West Germany *Scrap*	D-marks per 100 kilos	£/ton
Used copper wire	225	204 19
Heavy copper	225	204 19
Light copper	200	182 4
Heavy brass	150	136 13
Light brass	120	109 6
Soft lead	58	52 16
Zinc	57	51 18
Used aluminium unsorted	80	72 17

United States	c/lb	£/ton
Aluminium	26.00	207 4
Antimony 99·0	32.50	259 0
Cadmium	160.00	1,275 4
Copper: electrolytic	31.00	247 10
Lead	11.00	87 13
Nickel	74.50	593 15
Tin	120.00	956 8
Zinc: electrolytic	12.50	99 12

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ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 26 JUNE	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1961 HIGH	1961 LOW	1960 HIGH	1960 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	32/9	—9d.	11	9	6 14 3	33/9	26/3	35/–	26/6
400,000	2/–	Anti-Attrition Metal	1/3		NIL	4	NIL	1/3⅜	0/9	1/6	0/9
43,133,593	Stk. (£1)	Associated Electrical Industries ...	40/–		15	15	7 10 0	54/10½	39/6	67/3	38/3
3,895,963	1	Birfield	62/9	+2/9	10	15‡	3 3 9	78/9	45/–	51/3	29/–
4,795,000	1	Birmid Industries	90/–	—1/6	20	20D	4 9 0	103/–	71/3	74/9	56/–
8,445,516	Stk. (10/–)	Birmingham Small Arms	25/6		17½QT	12½	4 11 3	36/10½	24/9	30/6	18/3
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/6		5	5	6 18 0	14/6	13/9	17/4½	14/9
476,420	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/–		6	6	7 1 3	17/6	16/4½	20/–	17/1½
*300,000	1	Bolton (Thos.) & Sons Pref. 5% ...	16/6		5	5	6 1 3	16/6	13/9	16/–	14/3
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	16/3	—9d.	6	6	7 7 9	18/–	16/1½	21/1½	17/7½
18,846,647	Stk. (£1)	British Insulated Callender's Cables	60/–	+6d.	13½	13½	4 10 0	62/–	49/–	61/4½	47/–
20,456,599	5/–	British Oxygen Co. Ltd., Ord. ...	21/6	+2/3	16D	16	2 9 9	28/4½	17/6	35/–	19/10½
1,200,000	Stk. (5/–)	Canning (W.) & Co.	15/3	+3d.	15⅝	25+*2½C‡	5 4 6	20/9	13/7½	19/9	13/7½
60,484	1/–	Carr (Chas.)	1/–		NIL	12½	—	1/7½	10½d.	2/3	1/–
555,000	1	Clifford (Chas.) Ltd.	30/4½		12	10	7 18 0	30/4½	26/–	35/–	28/9
45,000	1	Ditto Cum. Pref. 6%	15/–xd		6	6	8 0 0	15/3	15/–	16/–	15/10½
300,000	2/–	Coley Metals	3/6xd		15	15	8 11 6	4/5½	3/6	5/–	3/4½
10,185,696	1	Cons. Zinc Corp.†	70/–	—1/–	20	15	5 14 3	81/6	64/–	80/9	59/6
5,399,056	1	Davy-Ashmore	152/–	—6/9	30‡	20	1 19 6	177/6	129/6	147/3	99/6
8,000,000	5/–	Delta Metal	23/1½	+4½d.	20	17½	4 6 6	27/7½	19/9	28/3	18/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	41/3	—1/3	15	15	7 5 6	52/3	41/3	56/9	45/–
1,155,000	1	Evered & Co.	45/9	+3d.	10B	10φ	2 18 3	45/9	42/6	42/9	29/3
18,000,000	Stk. (£1)	General Electric Co.	34/3	+6d.	10	10	5 18 6	39/6	29/6	47/9	29/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	60/–	—1/–	25	20	4 3 3	65/–	42/9	52/6	40/–
937,500	5/–	Glacier Metal Co. Ltd.	18/6	—6d.	15	13	4 1 0	21/1½	13/9	16/1½	11/1½
2,500,000	5/–	Glynwed Tubes	29/6		22½	25¶	3 16 3	30/3	23/7½	27/6	17/–
7,228,065	10/–	Goodlass Wall & Lead Industries ...	34/3		15	19L	4 7 6	44/9	33/9	41/9	33/–
696,780	10/–	Greenwood & Batley	25/–		15	30‡	6 0 0	29/6	23/9Z	33/6	29/1½
792,000	5/–	Harrison (B'ham) Ord.	13/3	—6d.	*20‡	*17½	3 15 6	14/6	12/–	15/10½	11/9
150,000	1	Ditto Cum. Pref. 7%	19/9		7	7	7 1 9	20/4½	19/9	23/6	22/–
1,612,750	5/–	Heenan Group	13/9	—9d.	13	15	4 14 6	17/1½	10/6	13/–	9/10½
251,689,407	Stk. (£1)	Imperial Chemical Industries ...	69/6	+3d.	13⅓	11½	3 19 0	81/6	63/1½	76/6	54/–
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	14/9	—3d.	5	5	6 15 6	16/–	14/9	18/–	15/4½
29,196,118	••	International Nickel	142½	+3	$1.60	$1.50	1 18 0	152½	104	105	84⅜
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	14/–		5	5	7 2 9	14/10½	13/6	16/6	14/6
6,000,000	1	Ditto Ord.	73/9	+5/–	15	12	4 1 6	73/9	59/6	67/6	44/9
600,000	10/–	Keith, Blackman	20/–		17½	17½E	8 15 0	21/6	18/3	32/6	17/6
320,000	4/–	London Aluminium	13/3xd		13	12	3 18 3	15/–	8/6	12/6	7/10½
765,012	1	McKechnie Bros. Ord.	64/3	—6d.	17½F	15F	5 8 9	68/–	53/6	71/6	57/3
1,530,024	1	Ditto A. Ord.	61/3	—1/9	17½F	15F	5 14 3	67/–	53/3	69/3	55/–
1,108,268	5/–	Manganese Bronze & Brass	16/–		20⅝	20⅝	6 10 0	18/6	14/–	18/6	13/4½
50,628	6/–	Ditto (7½% N.C. Pref.)	5/6	—3d.	7½	7½	8 3 6	6/–	5/3	6/6	5/9
26,361,444	Stk. (£1)	Metal Box	85/6	+6d.	12	12M	2 16 3	100/9	68/3	84/3	61/–
415,760	Stk. (2/–)	Metal Traders	7/–	—6d.	50	50	14 5 9	8/7½	6/9	10/9	7/1½
160,000	1	Mint (The) Birmingham	53/6		15	12½	5 12 3	53/6	36/–	39/–	33/6
80,000	5	Ditto Pref. 6%	76/3		6	6	7 17 6	77/6	76/–	80/–	75/–
5,187,938	Stk. (£1)	Morgan Crucible A	59/6	—2/–	14	13	4 14 0	71/3	53/4½	63/–	47/6
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	16/–		5½	5½	6 17 6	17/–	15/3	18/9	15/9
3,850,000	Stk. (£1)	Murex	45/6	+1/–	22½J	15	5 13 0	52/–	39/9	45/–	35/3
585,000	5/–	Ratcliffs (Great Bridge) Ord. ...	16/3	+3d.	10	10R	3 1 6	16/6	15/9	17/–	14/9
195,000	5/–	Ditto 8% Max. Ord.	5/–		8	—	8 0 0	5/1½	4/9	5/3	5/–
1,064,880	10/–	Sanderson Kayser	35/6	—2/–	17½	35‡	4 18 6	41/3	33/9	40/3	27/7½
3,400,500	Stk. (5/–)	Serck	18/4½	+9d.	12½	17½GD	3 8 0	19/3	15/–	25/6	15/3
8,035,372	Stk. (£1)	Stone-Platt Industries	55/6	—6d.	16	15	5 15 3	67/–	55/–	64/4½	52/3
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/–	—6d.	5½	5½	7 6 9	18/–	15/–	18/7½	15/3
35,344,881	Stk. (£1)	Tube Investments Ord.	70/6	+9d.	14	20	3 19 6	85/6	69/6	140/3	63/10½
41,000,000	Stk. (£1)	Vickers	33/–	—1/–	10	10	6 1 3	38/3	28/–	39/7½	27/1½
750,000	Stk. (£1)	Ditto Pref 5%	14/–	—6d.	5	5	7 2 9	15/–	12/7½	17/6	13/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	20/–	—3d.	*5	*5	7 8 9A	21/1½	19/9	24/6	20/1½
4,594,418	1	Ward (Thos. W.) Ord.	79/6	+6d.	13⅜	25	3 13 0	84/6	64/6	94/–	63/–
7,109,424	Stk. (£1)	Westinghouse Brake	40/9	—2/6	11	10	5 8 0	46/3	36/4½	60/6	37/6
323,773	2/–	Wolverhampton Die-Casting ...	9/–	+3d.	35	30	7 15 6	13/4½	8/9	13/10½	8/1½
591,000	5/–	Wolverhampton Metal	25/6	+2/3	32½	32½	6 7 6	30/–	23/3	39/9	23/9
156,930	2/6	Wright, Bindley & Gell	4/6	—1½d.	15	20‡	8 6 9	4/9	3/7½	4/6	2/10½
124,140	1	Ditto Cum. Pref. 6%	13/–		6	6	9 4 6	13/7½	13/–	15/–	13/6
150,000	1/–	Zinc Alloy Rust Proof	5/–		40	30	8 0 0	5/6	4/6	5/4½	4/–

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡and 100% capitalized issue. •The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units. φ and 6¼% from Capital Profits. B and 50% capitalized issue. G and 1⅝d. special distribution. F and special 5% tax free dividend. H As forecast. ¶And 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. J and 75% capitalized issue. S and 40% capitalized issue. O calculated at 13⅓%. Interim on smaller capital. P calculated at 11½% Q also 1/– special tax free dividend and 50% capitalized issue. T Per £1 unit. Z After capital reorganization. *The Thomas Bolton Ordinary Capital has been acquired by British Insulated Callender's Cables.

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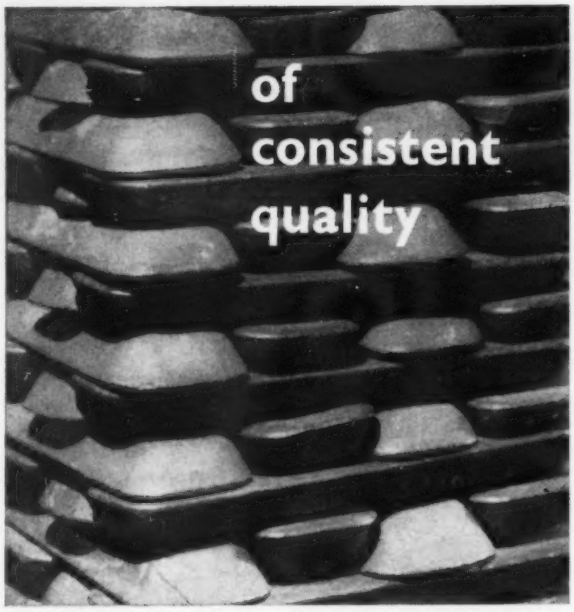

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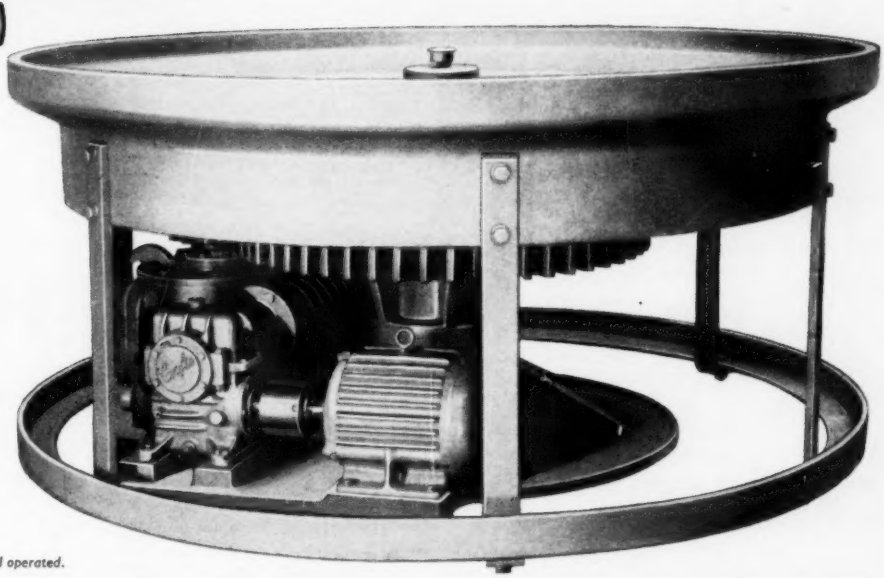

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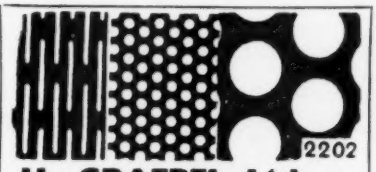

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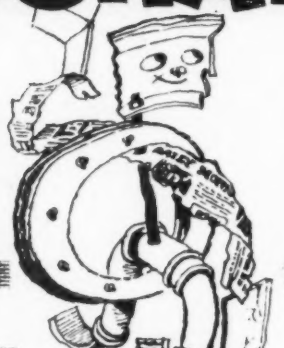

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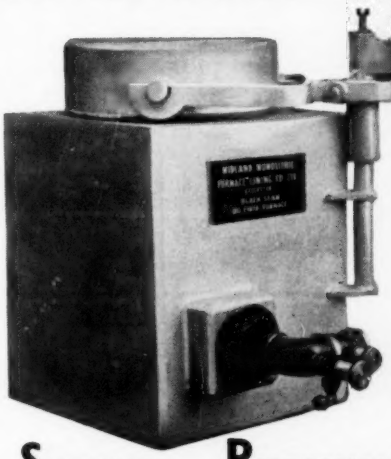

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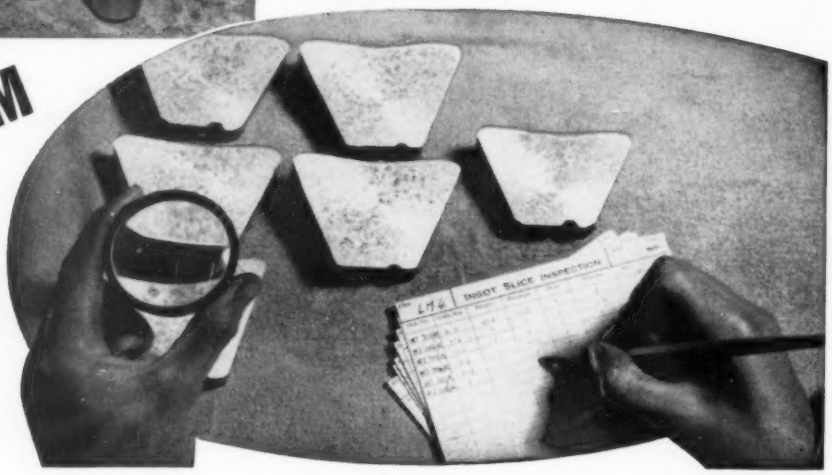

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